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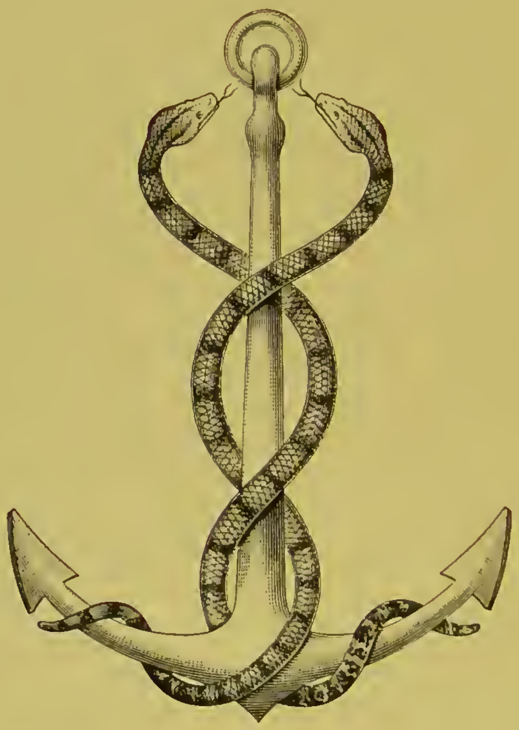

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# DISEASES

OF

# THE LIVER

## GALL BLADDER, AND BILIARY SYSTEM

*THEIR PATHOLOGY, DIAGNOSIS, AND SURGICAL TREATMENT*

BY

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# PREFACE.

The present volume is a revised version of the Jacksonian Prize Essay of the Royal College of Surgeons of England for the year 1894. The original Essay had two Appendices, one containing the clinical records of a considerable number of cases, and the other an account of some experimental investigations on the surgery of the liver and biliary system, which I carried out in the laboratories of the Royal Colleges of Physicians and Surgeons. In revising the Essay for publication, the subject-matter of these Appendices has been incorporated in the body of the work, and at the same time an account of the pathology of the different affections dealt with has been introduced.

For permission to publish the book I am indebted to the Council of the Royal College of Surgeons, and to them I beg to offer my thanks.

I am greatly indebted to the members of the staff of St. Bartholomew's Hospital, who have allowed me to examine the cases under their care and make use of their notes, and also for affording me the opportunity of having a number of drawings and photographs taken from the preparations in the museum of the Hospital.

I would also beg to offer my thanks to the friends who have assisted me in the preparation of the book, especially Dr. Edkins, for the chapter on physiology; Mr. W. Netterville

Barron, for making a number of the illustrations; and Messrs. D'Arcy Power and J. S. Sloane, for reading the proof sheets. I have also to thank Mr. J. S. Sloane for making the index.

A bibliography of the most important works and papers which have been published on diseases of the liver and biliary system, and which have been made use of in the preparation of the present volume, is placed at the end of the work.

Nearly all the references have been verified by myself as the work has been passing through the press.

H. J. WARING.

9 Upper Wimpole Street,
Cavendish Square, W.,
*April* 1897.

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# DISEASES OF THE LIVER, GALL BLADDER AND BILIARY SYSTEM.

# DISEASES OF THE LIVER.

## CHAPTER I.

### ANATOMY.

THE liver is the largest glandular organ in the human body, and is situated in the abdominal cavity at its upper part, and chiefly upon the right side. It occupies portions of the right and left hypochondriac, the epigastric, and the right lumbar regions (Fig. 1).

*Shape.*—It somewhat resembles a right-angled pyramid (Fig. 3) with some of the angles rounded off, which is placed transversely across the upper portion of the abdomen, the base being situated upon the right side, and the apex towards the left.

*Size.*—It measures about 10 to 12 in. in its longest diameter —that is, from the base to the apex of the pyramid; 6 to 7 in. antero-posteriorly; and about 3 to 4 in. from above downwards at the base or right lateral surface. As regards its bulk, the liver usually contains from 90 to 100 cubic inches of hepatic tissue.

*Weight.*—The weight varies within certain limits, but in the majority of healthy adults it is somewhere between 50 and 60 oz. According to Reid,[1] who has weighed the livers of 82 adult males, in 43 cases it was between 48 and 58 oz.; and in the adult female, in 17 cases out of 36 examined, it weighed between 40 and 50 oz. The average weight in the male was found to be 52 oz. 12½ drms., and in the female, 45 oz. 3½ drms.; and the difference in weight in the two sexes, 7 oz. 9 drms.

*Colour.*—The colour of the hepatic tissue is usually of a dark reddish-brown tinge (under healthy conditions), but this varies according to the amount of blood in the tissues. Generally the most dependent portion is almost purple.

---

[1] Reid, R., "Anatomical and Physiological Researches," 1848, p. 386.

*Consistency.*—The liver tissue feels solid when it is examined from the external surface, but when it is cut into, the exposed surface is somewhat friable, and is easily lacerated with the finger. By pressure it can be moulded into almost any shape, this pliability being frequently demonstrated, when the livers of women who have been accustomed to wear tightly-laced corsets, are examined post-mortem. After death the liver soon loses its pyramidal shape, and if it is removed from the body and left exposed to the atmosphere for a short time it quickly becomes flattened, and the various surfaces appear almost indistinguishable from one another.

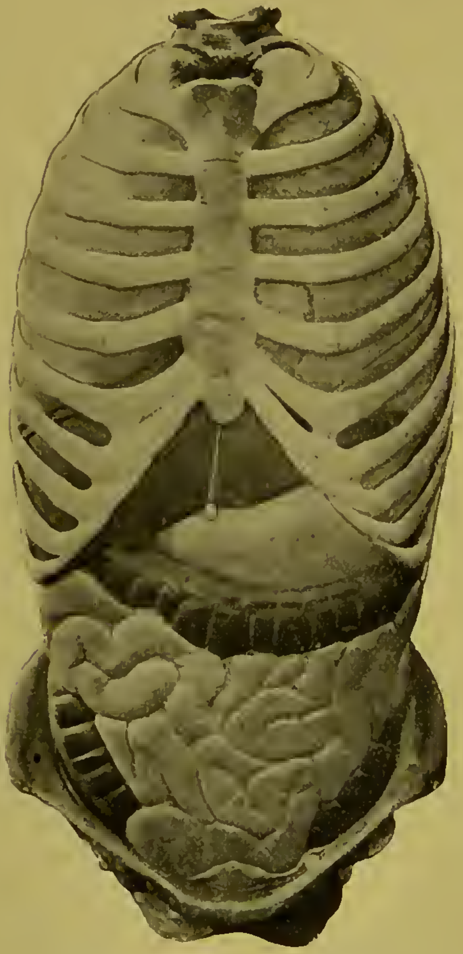

FIG. 1.—The abdominal and thoracic viscera as seen from in front.—*From a Model in the Dissecting Room of St. Bartholomew's.*

*Coverings.* — The greater part of the superficial surface of the liver is covered with a layer of the visceral peritoneum, one portion being derived from the greater sac and the remainder from the lesser sac. Posteriorly, however, there is a small triangular area, which is destitute of this covering. At various points the peritoneal covering is reflected from the external surface of the liver, to become continuous with the parietal layer; and it is in this manner that the peritoneal ligaments which help to hold the organ in its normal position within the abdomen are formed. Underneath the peritoneal covering there is a thin layer of dense fibrous tissue, which forms a complete investment for the whole gland, and is called the capsule of Glisson. From the deep surface of this layer, processes of fibrous tissue pass inwards into the substance of the organ and divide it up into lobes and lobules, the largest and most distinct process passing in at the portal fissure around the vessels which enter there.

*Surfaces.*—As we have already seen, the liver has the shape of a right-angled pyramid, which lies transversely across the upper portion of the abdominal cavity, the base being upon the right side and the apex on the left. Hence the liver has four surfaces, which correspond to the sides of the pyramid, a base or right lateral surface, and an apex. These surfaces are called (*a*) anterior, (*b*) superior, (*c*) posterior, (*d*) inferior, and (*e*) right lateral or base. They are separated from one another by borders, which are named (*a*) antero-inferior, (*b*) antero-superior, (*c*) postero-superior, (*d*) postero-inferior, and (*e*) the borders of the base. Many of these borders are rounded off, but some, as for example the antero-inferior, are quite sharp and well-defined. The *base or right lateral* surface is situated upon the right aspect of the gland as it lies in the upper portion of the abdominal cavity, and is in contact with the inferior surface of the right half of the diaphragm, where this structure lies on the inner surface of the lower ribs and costal cartilages. It is irregularly quadrilateral in shape, and is limited by four borders which separate it from the other surfaces. These borders are for the most part rounded off, except the inferior one and the lower part of the posterior, which are sharp and well-defined. The *anterior* surface (Fig. 3) is triangular in shape,

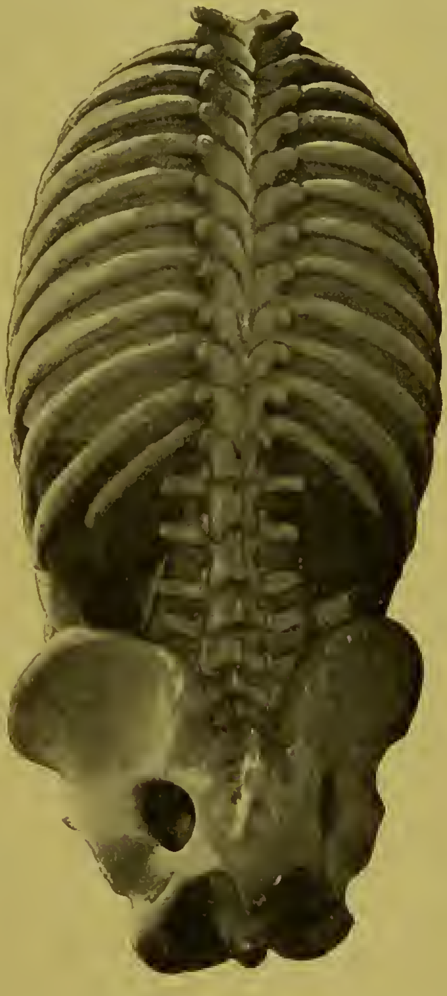

FIG. 2.—The abdominal and thoracic viscera as seen from behind.—*From a Model in the Dissecting Room of St. Bartholomew's.*

and is limited below by the sharp antero-inferior border, to the right by the rounded anterior border of the base, and above by the antero-superior border which separates it somewhat indistinctly from the superior surface; the apex of the surface lies towards the left in the left hypochondriac region. This surface is convex from below upwards, especially at its upper limit, and is covered completely with peritoneum. Opposite the middle line of the body the peritoneum is reflected over the remains of the umbilical vein or the ligamentum teres, so as to form a double fold of serous membrane, which is falciform in shape, and serves to fix the gland to the deep aspect of the anterior abdominal wall. This fold is called the falciform or suspensory ligament. Its line of attachment to the anterior and superior surfaces of the liver divides the gland into two main lobes, that portion which lies on the right side being the large right lobe, and that on the left the smaller left lobe. The antero-inferior border is notched in two places—first, opposite the middle line of the body, at the anterior portion of the attachment of the falciform ligament; and, secondly, at a point in the right lobe opposite the ninth and tenth costal cartilages. The first notch is deep and narrow, and is caused by the ligamentum teres as it passes to the trans-

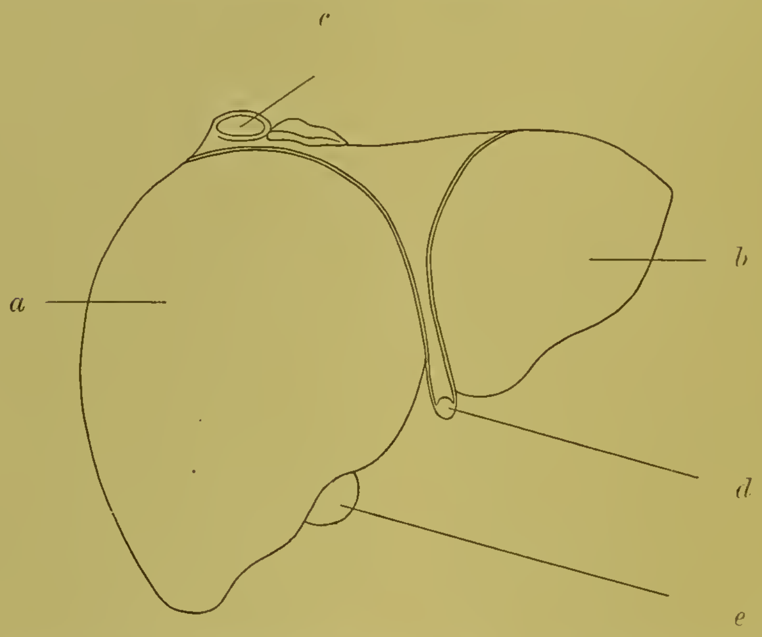

Fig. 3.—Diagram of the anterior aspect of the liver. *a*, right lobe; *b*, left lobe; *c*, inferior vena cava; *d*, suspensory ligament; *e*, fundus of gall bladder.

verse fissure; the second is much wider, and is quite shallow, being caused by the gall bladder (Fig. 3). The *superior* surface is also triangular in shape, and is limited in front by the antero-superior border, behind by the postero-superior border, and to the right by the superior border of the base, the apex lying towards the left. This surface is covered for the most part by peritoneum, derived from the visceral layer of the greater sac, and is divided into two parts by the attachment of the falciform ligament. The two layers of this ligament separate from one another a short distance in front of the postero-superior border, and become continuous with the peritoneum which, upon each side, leaves the superior surface of the liver to be reflected upon the inferior surface of the diaphragm, so as to form the anterior layer of the coronary ligament. This layer is continuous with the peritoneum which forms the anterior portion of the right and left lateral ligaments. A small area on the posterior part of the superior surface is uncovered by peritoneum. The antero-superior border and the superior border of the base are rounded off, and on this account the superior surface passes gradually into the anterior surface below and the base on the right. The postero-superior border is much sharper and better defined, and separates this surface from the posterior. It is notched in three places—first, by the œsophagus, which forms a wide and somewhat shallow groove, where it lies in contact with the left lobe; secondly, by the vena cava inferior, which forms a deep and wide groove immediately to the right of the middle line; and, thirdly, by the fibrous cord which is the remains of the ductus venosus, and forms a narrow notch just to the left of the one formed by the inferior vena cava. The *posterior* surface is triangular or somewhat rhomboidal in shape, and is bounded on the right by the posterior border of the base, which is rounded off at the upper part, but below is sharper in outline; above, by the postero-superior border; and, below, by the postero-inferior border, which is in reality divided into two portions by the projection downwards of the lobulus Spigelii. This projection, when well marked, causes the posterior surface to have a rhomboidal appearance. The surface is divided into two parts by the fissure for the ductus venosus or the posterior half of the great longitudinal fissure. That part which lies to the left of the fissure is triangular in shape, smooth, and covered with peritoneum, convex on the left and grooved on the right margin by the œsophagus, and it forms the posterior surface of the left lobe. The surface which lies to the right of the fissure is the posterior surface of the right lobe, and is subdivided into two portions by a large fissure which lodges the vena cava inferior. That part which lies to the left of the fissure is called the lobulus Spigelii; it is covered by peritoneum of the lesser sac, is quadrilateral in shape, and at its inferior extremity it is continuous with the inferior surface of the right lobe by a process of liver tissue which is named the lobulus caudatus. The part which lies on the right side of the vena cava inferior is for the most part convex, except as regards the lower and left extremity, where there is an impression for the right suprarenal capsule. This surface is rough and uncovered with peritoneum, and lies in close contact with the inferior aspect of the diaphragm. In some livers there is a bridge of hepatic tissue arching over the inferior vena cava so as to unite the lobulus Spigelii with the posterior surface of the right lobe. This, when present, is called the ponticulus hepatis. When viewed from behind, the posterior surface presents a large concavity, which is caused by the projection forwards of the anterior portion of the vertebral column and the pillars of the diaphragm. The *inferior* surface is extensive, and bounded in front by the thin sharp antero-inferior border, behind by the irregular postero-inferior border, and towards the right by the well-defined inferior border of the base. This surface is generally concave, and is divided into two parts by that portion of the great longitudinal fissure which lodges the ligamentum teres. That portion which lies to the left of the longitudinal fissure is somewhat concave, smooth, and covered with peritoneum, and presents a large impression where it lies in contact with the stomach, and a slight convexity immediately to the left of the longitudinal fissure which is called the tuber omentale. This eminence lies in contact with the anterior aspect of the gastro-hepatic omentum. The portion which is situated on the right side of the longitudinal fissure is subdivided into two parts by a large groove or fossa which runs in an antero-inferior direction, and lodges the gall bladder. This fissure is more than one inch wide in front, but as it nears the postero-inferior border it becomes much narrower. Connecting the posterior extremities of the fissure for the ligamentum teres and the fissure for the gall bladder, there is a deep fissure which is situated along the postero-inferior border, and called the transverse or portal fissure. It is here that the blood vessels and nerves enter the liver, and the lymphatic vessels and hepatic ducts have their exit. The portion of the inferior surface which lies between the umbilical fissure and the fissure for the gall bladder is called the quadrate lobe, on account of its shape. The remaining and largest portion of the inferior surface, which lies to the right of the gall bladder, is smooth and covered with peritoneum derived from the visceral layer of the greater sac, and has in front an impression for the hepatic flexure of the colon; behind this a large impression, which is caused by the upper portion of the right kidney; and at the left margin, just to the right of the gall bladder, a third impression, caused by its close relation with the duodenum, which lies in contact with it at this point.

*Ligaments.*—The liver is held in position in the abdominal cavity and fixed to the surrounding structures by means of ligaments, and also by its close connection with the inferior vena cava. These ligaments are reflections or folds of the peritoneum, with the exception of the ligamentum teres, which is the remains of the fœtal umbilical vein. The peritoneal ligaments are (*a*) falciform, (*b*) coronary, (*c*) lateral (right and left), and (*d*) gastro-hepatic, or the lesser omentum. The falciform ligament is a double fold of peritoneum, derived from the greater sac, which surrounds the remains of the umbilical vein; it is triangular in shape, its base being free and extending from immediately above the umbilicus to the notch which forms the anterior extremity of the great longitudinal fissure; whilst of the two sides, the upper is fixed to the deep surface of the anterior abdominal wall and the inferior surface of the diaphragm, along a line which is represented upon the surface of the body by the upper portion of the linea alba; the lower is attached to the anterior and superior surfaces of the liver, along a line which extends from the notch for the ligamentum teres in front, almost to the upper extremity of the fissure for the ductus venosus behind. This ligament consists of two layers of serous membrane, between which lie the remains of the umbilical vein, together with some small blood vessels and lymphatics. Along the line where the ligament is in contact with the liver, the two layers separate and become continuous with the peritoneum which covers the surface of the right and left lobes, and posteriorly it leaves the surface of the gland to form the anterior layer of the coronary ligament. The coronary ligament consists of two layers of peritoneum, which are not in apposition, but are separated from one another by those portions of the posterior and superior surfaces which are directly fixed to the inferior aspect of the diaphragm, and devoid of a peritoneal covering. The anterior layer of this ligament is formed by the reflection of the peritoneum, at the upper border of the bare area, from the liver to the lower surface of the diaphragm ; and the posterior or inferior layer is formed in a like manner by the reflection of the peritoneum from the inferior margin of the bare area to the inferior vena cava and the upper part of the right kidney. The right lateral ligament is a small fold of peritoneum which fixes the posterior portion of the right lateral surface to the inferior surface of the diaphragm, and it results from the juxtaposition of the two layers of the coronary ligament at the right extremity of the bare area. The left lateral ligament is larger than the right, and is somewhat triangular in shape, its base being directed towards the left, and having a concave free border. It consists of two layers of peritoneum, which are the lateral continuations of the left half of the coronary ligament, and it attaches the liver to the inferior surface of the diaphragm immediately in front of the œsophageal aperture. The gastro-hepatic, or lesser omentum, is a double fold of peritoneum which passes from the transverse fissure of the liver to the lesser curvature of the stomach. The anterior layer is derived from the greater sac, and is continuous above with the peritoneum upon the inferior surface of the liver, whilst below it passes into the layer of peritoneum which covers the anterior surface of the stomach. The posterior layer is part of the anterior wall of the lesser sac, and is continuous above with the inferior portion of the coronary ligament, and below with the layer which clothes the posterior aspect of the stomach. On the right it presents a free, somewhat thickened border, which extends from the right extremity of the portal fissure to the upper border of the first part of the duodenum, and it forms the anterior boundary of the foramen of Winslow, whilst upon the left the two layers become continuous with the serous coats of the stomach. This ligament is thickest on the right, where it has between its two layers the hepatic artery and the bile duct, together with the portal vein and the lymphatic vessels and nerves. Towards the left it is much thinner, and has small holes in it which give it a fenestrated appearance (Fig. 8).

*Fissures.*—The following fissures are met with upon the various surfaces of the liver, namely, (*a*) the longitudinal fissure, (*b*) the transverse fissure, (*c*) the fissure for the gall bladder, (*d*) the fissure for the inferior vena cava. The longitudinal fissure is a deep groove, which commences at the antero-inferior border and extends directly backwards to the left extremity of the transverse fissure, beyond which it is continued vertically upwards across the posterior surface as far as the postero-superior border, dividing the inferior and superior surfaces into right and left portions. It is the boundary between the right and left lobes upon these surfaces. Its direction corresponds exactly with the line of attachment of the falciform ligament upon the anterior and superior surfaces. The portion of the fissure on the inferior surface is called the umbilical fissure, and in it lies the remains of the umbilical vein, which is now called the ligamentum teres. In some livers this fissure is partially converted into a tube or canal by a process of liver tissue bridging it over, which, when present, is called the pons hepatis. That portion of the fissure which is situated on the posterior surface is called the fissure for the ductus venosus, since it contains a fibrous cord which is the morphological remains of this structure. The transverse fissure is a somewhat deep sulcus situated along the postero-inferior border, and commencing at the longitudinal fissure, whence it extends to the right for about two inches. At this fissure the ducts and lymphatics of the gland have their exit, and the portal vein, hepatic artery, and nerves, their entrance. The fissure for the gall bladder is a broad groove, somewhat wider in front than behind, which runs across the inferior surface, and extends from the right extremity of the transverse fissure to the antero-inferior border, almost parallel with the anterior portion of the longitudinal fissure. In it lie the gall bladder and the cystic duct. The fissure for the inferior vena cava is a deep groove upon the posterior surface, to the right of the posterior portion of the longitudinal fissure, which runs obliquely from below and on the right, *upwards to* the left. The inferior vena cava lies in it, and it is occasionally converted into a canal by a process of liver tissue, which passes superficial to the vein. This process, when present, is called the ponticulus hepatis.

*Lobes.*—The liver is primarily divided into a large right and a small left lobe by the longitudinal fissure on the inferior and posterior surfaces, and the attachment of the falciform ligament on the superior and anterior surfaces. The posterior and anterior surfaces are further subdivided. Upon the inferior surface that portion of the liver which is situated between the umbilical fissure and the fissure for the gall bladder, is, from its quadrilateral shape, named the quadrate lobe; and, as we have already seen, the bridge over the umbilical fissure, when it exists, is called the pons hepatis. On the posterior surface that portion of the gland which lies between the fissure for the ductus venosus and the fissure for the inferior vena cava is known as the lobulus Spigelii, and the occasional process over the fissure for the vena cava is called the ponticulus hepatis. The part of the liver which connects the inferior surface of the right lobe and the lobulus Spigelii is called the lobulus caudatus.

*Blood vessels.*—The hepatic artery is a large vessel, measuring more than one quarter of an inch in diameter, which conveys nearly the whole of the arterial blood going to the liver (Fig. 4). It is one of the terminal branches of the cœliac axis, and is given off from this vessel at the upper border of the head of the pancreas. From its origin it first passes forwards in an antero-posterior direction, bending slightly to the right over the upper border of the pancreas and below the lower margin of the foramen of Winslow, in order to reach the upper part of the pyloric end of the stomach, where it gives off its first branch, the arteria gastro-duodenalis; next, it curves slightly backwards and gives off a pyloric branch to the lesser curvature of the stomach, and then ascends between the two layers of the gastro-hepatic omentum, where it is surrounded by some connective tissue, which separates it from the common bile duct on the right and the portal vein behind. The artery, as it ascends, lies in front of the lesser sac of the peritoneum, immediately to the left of the foramen of Winslow, and after a course of about 1½ or 2 in. it reaches the neighbourhood of the transverse fissure, a short distance from which it divides into its two terminal branches, the right and left hepatic arteries. The right hepatic artery passes obliquely to the right, and crosses generally behind the hepatic and cystic ducts, but occasionally in front of the hepatic duct, and gives off the cystic artery to the gall bladder. After a short course it reaches the right extremity of the transverse fissure of the liver, where it divides into several branches, usually two to four, which immediately pass into the substance of the liver. The cystic artery passes between the cystic and hepatic ducts in its course to the neck of the gall bladder, where it divides into two branches, the superior and inferior cystic arteries. The superior ramifies in the coats of the gall bladder, supplying that portion of the viscus which lies in direct relation with the inferior surface of the liver, whilst the inferior supplies the peritoneum-covered surface of the gall

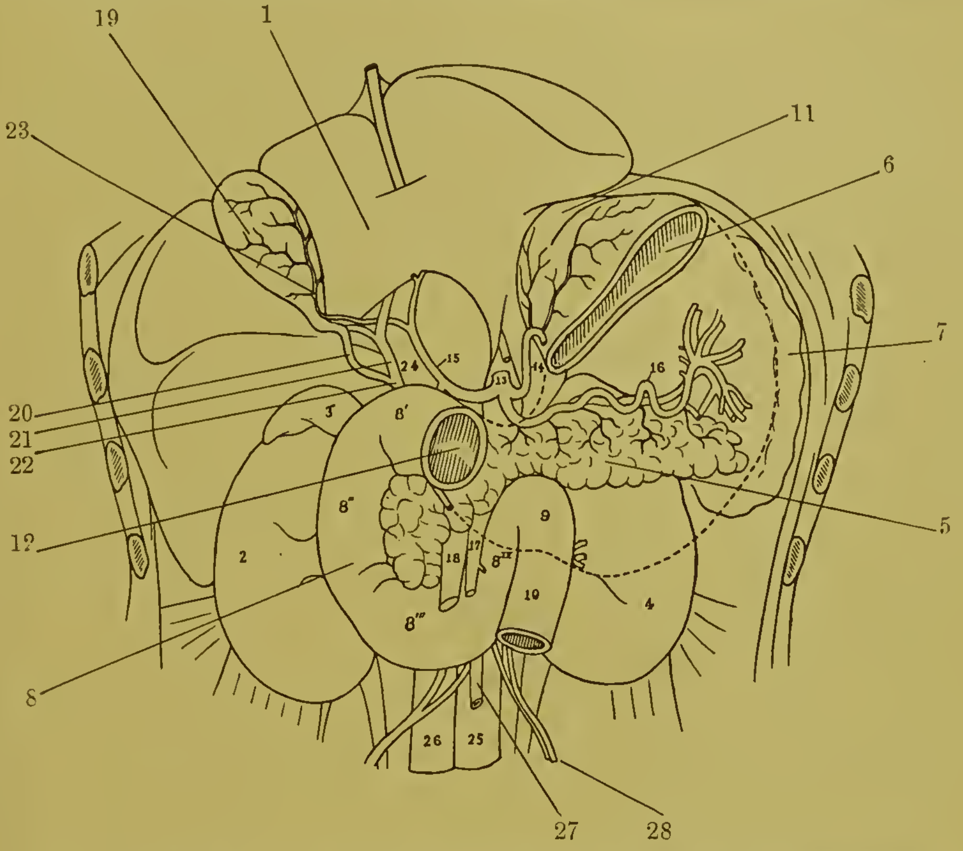

FIG. 4.—Diagrammatic view of the structures in the portal fissure of the liver and on its inferior surface, together with the adjacent viscera. (After TESTUT.)

1. Inferior aspect of liver.
2. Right kidney.
3. Right suprarenal capsule.
4. Left kidney.
5. Pancreas.
6. Cardiac portion of stomach.
7. Spleen.
8. Duodenum.
    - 8'. ,, 1st part.
    - 8''. ,, 2nd ,,
    - 8'''. ,, 3rd ,,
    - $8^{iv}$. ,, 4th ,,
9. Junction of duodenum and jejunum.
10. Jejunum.
11. Cardiac orifice of stomach.
12. Pylorus.
13. Cœliac axis.
14. Arteria gastro-duodenalis.
15. Hepatic artery.
16. Splenic artery.
17. Superior mesenteric artery.
18. Superior mesenteric vein.
19. Gall bladder.
20. Cystic duct.
21. Common hepatic duct.
22. Common bile duct.
23. Cystic artery.
24. Portal vein.
25. Aorta.
26. Inferior vena cava.
27. Inferior mesenteric artery.
28. Spermatic artery.

bladder in a similar manner. The left hepatic artery is considerably smaller than the right, is given off from the main trunk at an acute angle, and passes obliquely to the left, towards the left extremity of the transverse fissure. In its course it gives off one or two small branches to the lobulus Spigelii, and then terminates by dividing into two or three branches, which pass directly into the liver at the left extremity of the transverse fissure. The branches of the hepatic artery accompany the branches of the portal vein and bile ducts in the substance of the liver. The minute distribution of the terminal branches will be given with the histology of the gland.

*Abnormalities of the hepatic artery.* — The hepatic artery presents several varieties as regards its origin. It may arise directly from the abdominal aorta, or as a branch from the superior mesenteric or splenic arteries. The cystic artery may also come from the superior mesenteric vessel. Small accessory hepatic arteries have been described as taking origin from the coronary, superior mesenteric, inferior mesenteric, the abdominal aorta, or the right renal.[1]

*Portal vein.*—The portal vein is a wide and somewhat thin-walled vessel, which commences in front of the body of the first lumbar vertebra, and is formed by the union of the superior mesenteric and splenic veins. At its commencement it lies a short distance to the left of the inferior vena cava, and has the head of the pancreas in front; in its course upwards it inclines slightly to the right, and passes behind the head of the pancreas and the first portion of the duodenum, and then it enters the gastro-hepatic omentum, between the two layers of which it runs to the transverse fissure of the liver. As the vein lies in the gastro-hepatic omentum it has the common bile duct and the hepatic artery in front, the former being on the right and the latter on the left; it is also surrounded by a considerable amount of fibrous connective tissue, which is continuous with Glisson's capsule; and in this tissue lie the efferent lymphatic vessels of the liver and numerous filaments of the hepatic plexus of nerves. When the portal vein reaches the right extremity of the transverse fissure, the lumen of the vessel becomes dilated so as to form a localised enlargement, called the sinus of the portal vein, immediately beyond which it divides into two branches, a large and short right and a smaller and longer left. The right branch enters the substance of the liver at the right extremity of the transverse fissure, and divides into a number of branches, each of which is accompanied by a branch of the hepatic artery and one of the small bile ducts. The left branch courses across to the left extremity of the transverse fissure, where it enters the liver and divides and ramifies in a similar manner to the right. As the left branch of the portal vein crosses the longitudinal fissure, it is connected in front with the ligamentum teres by a fibrous cord, which is a part of the remains of the fœtal umbilical vein, and behind with the inferior vena cava by a similar cord, which is the remains of the ductus venosus. As the portal vein passes through the gastro-hepatic omentum it receives the pyloric and coronary veins, and the right division the cystic vein from the gall bladder. The portal vein measures about 3 in. in length. In the adult the portal vein and its larger tributaries contain no valves, but, in the child, valves are said to be present in the veins of the stomach and intestine, which soon disappear (Hochstetter and Bryant quoted by Quain).[1] Accessory portal veins have been described by Baumgarten [2] and Sappey.[3] These are small veins which return the blood from the peritoneal ligaments of the liver, and enter the liver substance either directly or by joining the branches of the portal vein.

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[1] Quain's "Anatomy," 10th edition, vol. ii. pt. i. p. 460.

*Communications between the portal vein and the general venous system.* — These are important because they are liable to become enlarged in certain hepatic affections and give rise to definite symptoms. They are the following, namely, (*a*) a small vein, which is the remains of the umbilical vein; it commences in the region of the umbilicus, where it communicates with the epigastric veins and the small veins of the anterior abdominal wall, and then runs in the ligamentum teres to join the left division of the portal vein; (*b*) occasional parumbilical veins, which lie in the superficial part of the ligamentum teres, and communicate externally with veins in the region of the umbilicus, and internally with the portal vein or the unobliterated remains of the umbilical vein; (*c*) small anastomoses between the veins of the pancreas and the veins of the adjacent portion of the posterior abdominal wall; (*d*) small veins of the second and third portions of the duodenum, which have communication with the veins of the posterior abdominal wall; (*e*) the veins of the ascending and descending colon with the veins of the posterior abdominal wall; (*f*) veins in the walls of the second and third portions of the rectum, which are connected with the tributaries of the internal iliac vein; (*g*) veins of the lower part of the rectum which communicate with the inferior hæmorrhoidal veins; (*h*) the communications between the tributaries of the coronary vein and the œsophageal veins.

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[1] Quain's "Anatomy," 10th edition, vol. ii. pt. i. p. 543.

[2] Baumgarten, *Centralbl. f. d. med. Wissensch.*, Berlin, Bd. xv. s. 721.

[3] Sappey, *Mém. Acad. de méd.*, Paris, tome xxiii. p. 269.

*Hepatic veins.*—The blood which has been conveyed to the liver by the hepatic artery and the portal vein is collected by the radicles of the hepatic veins, which commence within the substance of the liver, and then unite to form the larger hepatic veins. The hepatic veins are usually two or three in number, occasionally more, and have the form of large, short, wide vessels, which open into that portion of the inferior vena cava which lies in the groove upon the posterior surface of the liver. In their course through the liver the hepatic veins run obliquely upwards. At the point of entrance into the inferior vena cava a semilunar fold of tissue is present, and forms at each aperture an imperfect kind of valve, and with this exception there are no valves in the hepatic veins. In order to see these veins, after the liver has been removed from the body, the vena cava should be slit open from behind, when the gaping openings of the hepatic veins will be seen. In rare cases the hepatic veins have been seen to pierce the diaphragm, and open separately by one or two trunks into the right auricle. Breschet has described single hepatic openings into both right and left auricles, and Rothe has seen a single hepatic vein pierce the diaphragm, and open directly into the left auricle, the aperture being guarded by a valve. When the inferior vena cava passes upwards in company with the aorta, and joins the superior vena cava, the hepatic veins unite and form a single trunk, which passes through the diaphragm in the usual position for the aperture of the inferior vena cava, and then joins the right auricle.

*Inferior vena cava.*—The upper portion of the abdominal vena cava is situated within a deep groove, which is occasionally converted into a canal, on the posterior surface of the liver, between the right border of the lobulus Spigelii and the left border of the posterior surface of the right lobe. This groove is wide and deep, and the vein is firmly fixed to the connective tissue capsule of the liver by the union of the outer coat of the vein and the connective tissue of Glisson's capsule, and also by the junction of the hepatic veins with the inferior vena cava. The groove is generally deeper above than below, owing to the fact that the vein passes slightly forwards before it pierces the diaphragm to join the right auricle. The bridge of liver tissue, which occasionally overlaps the vein and converts the groove into a canal, is called the ponticulus hepatis. The portion of the inferior vena cava which lies in relation with the liver measures from 1½ to 2 in. in length.

*Lymphatics.*—The lymphatic vessels by which the lymph is conveyed from the liver may be divided into two sets, (*a*) an *external* set, which lie upon the external surface of the liver, underneath the peritoneal covering, and in or upon the connective tissue of the capsule of Glisson; (*b*) an *internal* set, which lie within the substance of the liver, and accompany the branches of the portal vein and the hepatic artery. The external set of lymphatic vessels leave the liver at many points, and on this account they can be subdivided into the following groups, namely, (1) Those which pass upwards along the falciform ligament. The lymphatics from the greater portion of the superior surface and the upper part of the anterior surface of the liver all converge towards and join together in the falciform ligament, between the layers of which they pass to the aperture between the diaphragm and the ensiform cartilage, whence they run into the thorax and open into the lower lymphatic glands in the anterior mediastinum. (2) The lymphatics from the median portion of the posterior surface. These vessels pass between the layers of the coronary ligament, pierce the diaphragm, and then join the lymphatic glands around the thoracic portion of the inferior vena cava. The lymphatic vessels from the left part of the posterior surface join the lymphatics around the œsophagus. (3) The lymphatics from the lower portion of the posterior surface, from the greater part of the inferior surface, and from the lower portion of the anterior surface, pass to the transverse fissure, where they join some of the deep lymphatics, and then pass into the glands which lie in the gastro-hepatic omentum. (4) The lymphatics from part of the right lateral surface pass between the layers of the right lateral ligament, and then generally pierce the diaphragm and join the glands in the mediastinal space, or cross the crus of the diaphragm, and empty themselves into the receptaculum chyli. (5) The lymphatics from the apex of the left lobe pass between the layers of the left lateral ligament, and join the œsophageal lymphatics around the œsophageal opening in the diaphragm, or they pierce the diaphragm and join the glands in the anterior mediastinum.

The *internal* set of lymphatics emerge from the liver at two points, and on this account are divided into portal and hepatic groups—(1) The portal group pass out from the liver at the transverse fissure, and run into the gastro-hepatic omentum, where they are joined by some of the external set, and then empty into the hepatic glands, whence they pass into the cœliac glands and the thoracic duct. (2) The hepatic group emerge from the liver, along with the hepatic veins, in the groove for the inferior vena cava, and then pierce the diaphragm, along with that vessel, and enter the glands around its thoracic portion, whence vessels pass over the thoracic aspect of the diaphragm and join the lower portion of the thoracic duct.

*Nerves.*—At the portal fissure of the liver there is a dense plexus of nerves which surrounds the portal vein, the hepatic artery, and bile ducts, and is called the hepatic plexus. It receives branches from the solar plexus, some branches from the right vagus, and a larger number from the left. Nerves pass inwards from this plexus and accompany the branches of the hepatic artery and the portal vein. The ultimate distribution of these nerves is not exactly known, but ganglia have been described as occurring upon them in their course within the liver. Pflüger has described some of these nerve fibres, and asserts that they terminate in the hepatic cells. MacCallum[1] says that an interlobular plexus of non-medullated fibres is formed, from which pass perivascular and intercellular plexuses. Korolkow[2] and Berkley[3] have recently confirmed and extended MacCallum's observations.

*Biliary apparatus.*—The biliary apparatus, formed by the excretory ducts of the liver, consists of (*a*) the right, left, and common hepatic ducts; (*b*) the gall bladder and cystic duct; and (*c*) the common bile duct. The right hepatic duct commences near the right extremity of the transverse fissure, and passes slightly downwards and towards the left, where it joins the left hepatic duct coming from the left extremity of the transverse fissure, to form the common hepatic duct. The common hepatic duct measures about 3 c.c. in length, and is situated between the layers of the gastro-hepatic omentum, where it is directed downwards and to the right. It lies in front of the portal vein, and has the hepatic artery on its left (Fig. 8). At its lower extremity it is joined on its right side by the cystic duct, which comes from the gall bladder. The duct which is formed by the union of the cystic duct and the common hepatic duct, is called the common bile duct, or the ductus communis choledochus.

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[1] MacCallum, *Quart. Journ. Micr. Sc.*, London, 1887, p. 439.

[2] Korolkow, *Anat. Anz.*, Jena, 1893, s. 751.

[3] Berkley, *ibid.*, 1893, s. 769.

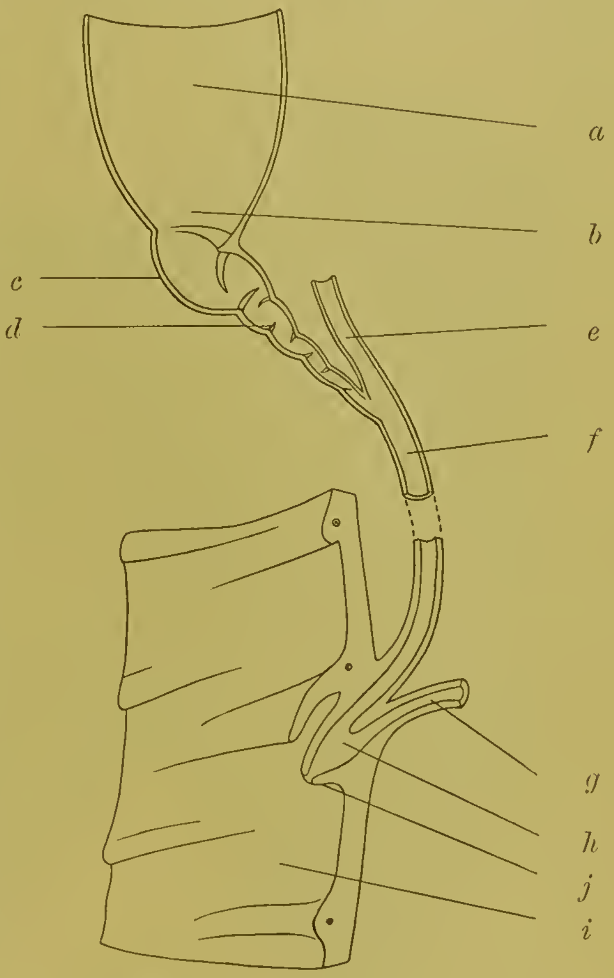

Fig. 5.—The gall bladder and biliary ducts. *a*, cavity of gall bladder; *b*, neck of gall bladder; *c*, cystic duct; *d*, spiral valve of cystic duct; *e*, common hepatic duct; *f*, common bile duct; *g*, duct of pancreas; *h*, ampulla of Vater; *i*, second portion of duodenum; *j*, biliary papilla. (After Testut.)

The gall bladder is a hollow sac, pyriform in shape, which lies in a fossa on the inferior surface of the liver between the quadrate and right lobes. The sac measures about 10 cm. in length, 3 cm. in width at the base, and it has a capacity of about 20 c.c. The gall bladder consists of a fundus, a body, and a neck. The fundus is the lowest portion, and is directed downwards, forwards and towards the right, and when it is distended it lies behind the ninth right costal cartilage, protruding a little beyond, so as to come into contact with the posterior surface of the anterior abdominal wall. This part is completely covered with peritoneum. The body is that part of the gall bladder which lies between the fundus and the neck.

It lies in the fossa for the gall bladder, and is attached on its upper and anterior surface by connective tissue to the inferior surface of the liver. The lateral, inferior, and posterior surfaces are covered with peritoneum, which is reflected on to the inferior surface of the liver. The lower surface of the gall bladder is in contact with the first part of the transverse colon,

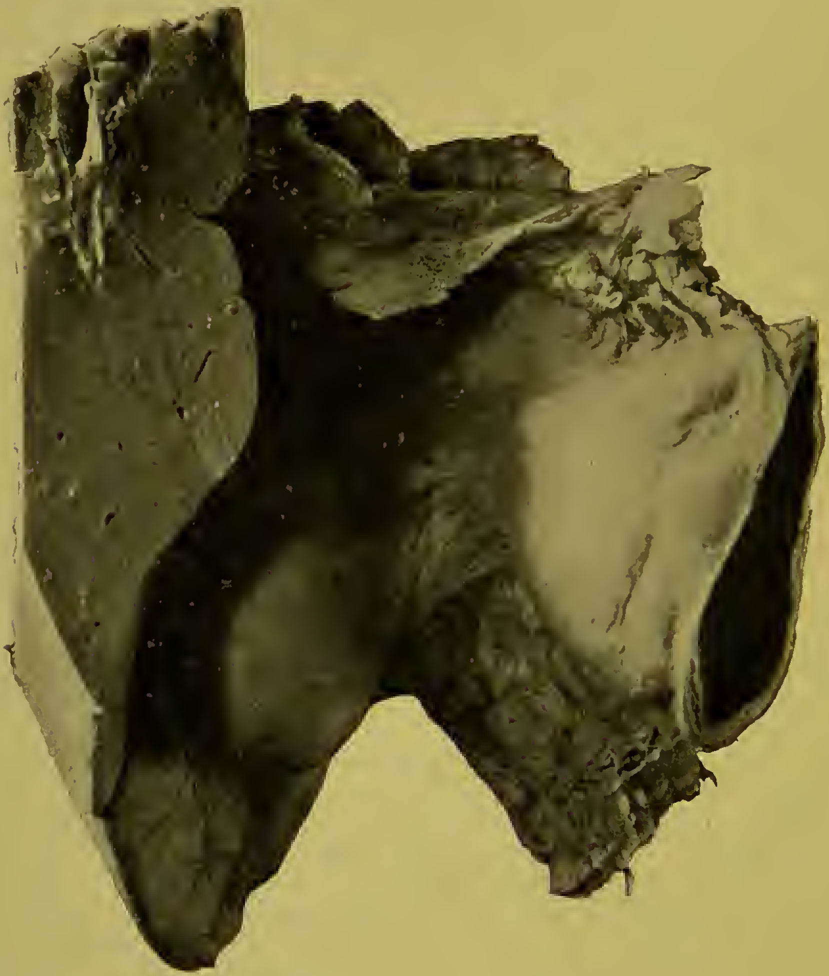

FIG. 6.—Portion of the right lobe of the liver, the gall bladder, and the colon, showing the mesentery which occasionally fixes the gall bladder to the colon.

the first portion of the duodenum, and occasionally with the pylorus. The gall bladder may be fixed to the transverse colon by a fold of peritoneum, extending from the inferior aspect of the former viscus to the upper border of the latter. This condition is illustrated in Fig. 6. In rare cases the gall bladder has a mesentery, and when this is present it is suspended to the inferior surface of the liver. Hochstetter[1] has recorded a case in which the gall bladder was attached to the liver on the left side of the middle line, and in which there was no transposition of viscera. The mucous membrane of the gall bladder, when seen from the interior, is thrown into a number of folds which give it a honeycombed appearance (Fig. 7). As the body of the gall bladder nears the transverse fissure of the liver, it becomes narrower, and passes into the constricted portion or neck. The neck becomes narrower as it passes backwards, and is folded upon itself in an S-shaped manner, and when it reaches the transverse fissure it passes into the cystic duct. The cystic duct is a small canal, 2·5 to 3·5 c.c. in length, which passes backwards and towards the left in the gastro-hepaticomentum, where it joins at an acute angle the common hepatic duct on its right side, so as to form the common bile duct. The mucous membrane of the cystic duct is thrown into a number of folds, which are called the valves of Heister. These valves usually have a spiral arrangement. The common bile duct measures about 7·5 c.c. in length, and in diameter 5 to 6 mm. It passes downwards, first between the layers of the gastro-hepatic omentum, lying to the right of the hepatic artery and in front of the portal vein, then behind the first portion of the duodenum, and finally between the left aspect of the second part of the duodenum and the right margin of the head of the pancreas, to terminate in the lower part of the descending portion of the duodenum. After passing for three-quarters of an inch obliquely through the intestinal wall, it opens into the duodenum on the top of a small eminence, which is called the biliary papilla, and

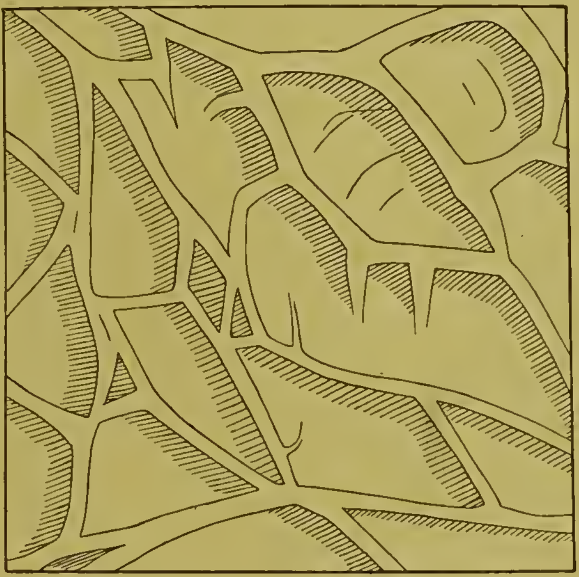

FIG. 7.—Mucous membrane of gall bladder as seen from the interior. (After TESTUT.)

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[1] Hochstetter, *Arch. f. Anat. u. Entwcklngsgesch.*, Leipzig, 1886, s. 369.

is situated on the posterior and left aspect of the intestine. As the common bile duct passes through the wall of the duodenum, it is joined on its left side by the duct of the pancreas, and then becomes dilated so as to form a small fusiform sac, which is called the ampulla of Vater. There is a slight constriction in the lumen of the duct at its point of entrance into the duodenum. The cystic duct and the gall bladder receive a small arterial branch from the right hepatic artery, which is called the cystic artery, and this vessel ramifies in the walls of both these structures. The cystic vein opens into the portal vein or into its right division. Purser[1] has described a case in which two gall bladders were met with, each sac having a distinct duct which joined the hepatic duct separately.

*Hepato-cystic ducts.*—It occasionally happens that small bile ducts pass directly from the liver substance to the gall bladder. When these are present they are called hepato-cystic ducts. They have, however, only very rarely been observed in man.

*Topographical anatomy of the liver.*—The liver, as we have already seen, lies in close contact with the lower surface of the diaphragm; and below, it is in relation with the stomach, the first and second portions of the duodenum, the right kidney and suprarenal capsule, and the hepatic flexure of the colon. The liver, in an adult who is in the erect position, extends only a very short distance below the costal margin; usually it extends about one-third or half an inch below the ribs, from the ninth to the twelfth, upon the right side. The apex of the left lobe of the liver is situated in the left side of the abdomen, about two or two and a half inches from the middle line of the sternum, and lies behind the lower border of the junction of the sixth rib with its cartilage. Behind, the liver extends downwards as far as the first lumbar spine. Hence the lower border of the liver will be represented by a line which commences behind at the spine of the first lumbar vertebra, and passes forwards and upwards to the lower part of the eleventh rib, and thence along the costal margin of the right side to the ninth costal cartilage, whence it crosses the subcostal angle to the eighth costal cartilage of the left side, and is then continued to the apex which lies behind the junction of the sixth rib with its cartilage at its lower border. The upper border of the liver is represented by a line which commences opposite the lower border of the sixth rib, at the junction with its cartilage, and passes to the right across the middle line just above the junction of the gladiolus sterni with the xiphoid cartilage, and thence to the junction of the fifth rib with its costal cartilage, from which point the line is carried first downwards and to the right, and then abruptly downwards to the spine of the first lumbar vertebra.

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[1] Purser, *Trans. Acad. Med. Ireland*, Dublin, vol. v. p. 243.

The height of the liver varies with the movements of respiration; thus, during inspiration, the lower border is somewhat below the above-mentioned line; whilst during expiration it lies above that level. In the recumbent position the greater portion of the liver recedes underneath the ribs, and only a small part in the subcostal angle can be felt.

The liver is proportionately much larger in children, especially in infants, than in the adult. On this account the lower margin of the gland extends a variable distance below the costal border. It may be felt in some cases to extend one-third of the way towards the umbilicus. The left lobe also is comparatively much larger in children, and on this account it extends beyond the nipple line, and passes towards the neighbourhood of the spleen.

*The gall bladder* lies in the right hypochondriac region, its fundus being situated immediately behind the ninth right costal cartilage. In the erect position the fundus projects a little below the costal margin, but in the recumbent position it usually lies completely hidden by the ribs and their costal cartilages. The main part of the vesicle lies at a higher level and in a much deeper plane.

*The common bile duct* lies at first in the gastro-hepatic omentum, a little to the right of the middle line, and the last part behind the duodenum, and slightly more to the right. It must be remembered that the common bile duct is in very close relation with the portal vein, which lies immediately behind it and to the left; whilst the hepatic artery is just to the left, and in the same plane. Immediately behind these structures, and only separated by the two layers of peritoneum which are the boundaries of the foramen of Winslow, there lies the inferior vena cava, and a little further to the left the abdominal aorta (Fig. 8).

*The development of the liver.*—In early fœtal life the stomach and duodenum are connected with the anterior body wall by a mass of mesoblastic tissue, which has been termed the *ventral alimentary mesentery.* In this run the two vitelline veins, bringing the blood from the yolk sac. The body cavity is in this early condition bilaterally symmetrical. There arises from the fore-gut in the human embryo, before the fifteenth day, a short hollow diverticulum, and shortly afterwards a second diverticulum appears. A close network of anastomosing rods of cells is formed from these rudiments. The arrangement of the gland at this stage resembles the permanent condition in the reptile and amphibian. This development of cell cylinders, derived, of course, from the hypoblast, occurs in the ventral alimentary mesentery. At the same time, the vessels in this tissue multiply, and thus furnish a blood supply to the primitive liver, which has, however, a somewhat complicated arrangement. The original hollow diverticula from the fore-gut represent the right and left hepatic ducts. Where they open into the duodenum an outgrowth gradually develops, and in this way the bile duct is formed. In the second month a subordinate outgrowth from this occurs to form the cystic duct and the gall bladder. The bile capillaries arise by a canalisation of the

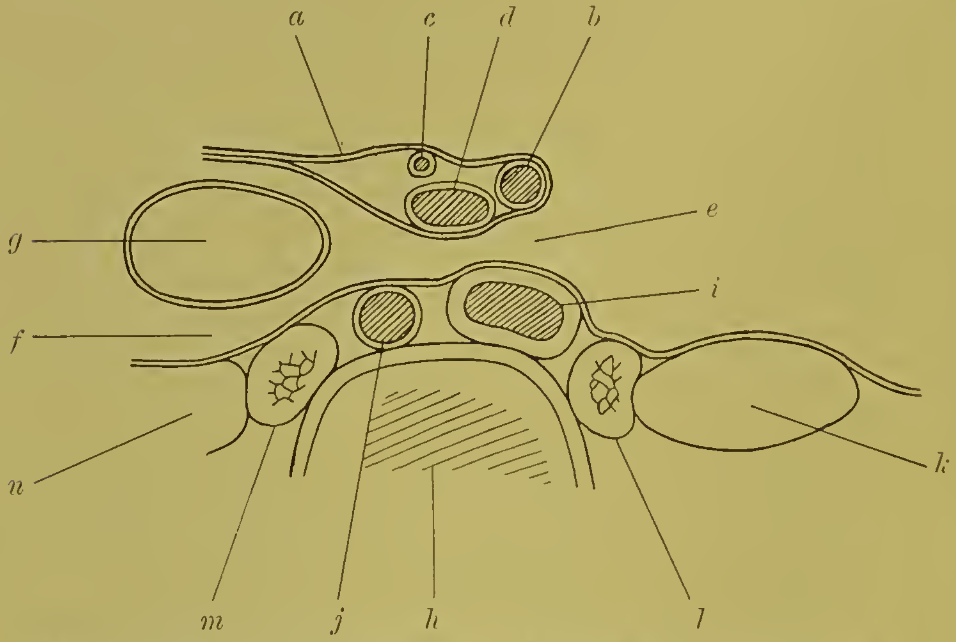

FIG. 8.—Diagram of a section through the gastro-hepatic omentum, at the level of the foramen of Winslow. *a*, Lesser omentum or gastro-hepatic omentum : *b*, common bile duct ; *c*, hepatic artery ; *d*, portal vein ; *e*, foramen of Winslow ; *f*, lesser sac of peritoneum ; *g*, lobulus Spigelii ; *h*, twelfth dorsal vertebra ; *i*, inferior vena cava ; *j*, abdominal aorta ; *k*, right kidney : *l*, right suprarenal capsule ; *m*, left suprarenal capsule ; *n*, left kidney.

primitive cell cylinders; and, as the tubular arrangement of the liver gradually becomes lost, these bile capillaries are found to be bounded simply by two liver cells. These bile capillaries branch freely and anastomose laterally, and thus an individual liver cell comes to have a bile capillary on more than one aspect. At first the liver is symmetrical, but after the fourth month the right lobe begins to preponderate. At the end of the second month the liver forms a large part of the weight of the whole embryo—roughly, one-half; and this predominance of the organ naturally suggests important functions during early embryonic life. It presumably modifies the nutrient matter brought by the allantoic (umbilical) veins, and during embryonic and fœtal life acts also as an excretory organ. The size of the liver, compared with the rest of the body, gradually diminishes as gestation proceeds, so that at birth the proportion is 1 to 18.

The ventral alimentary mesentery also conducts the allantoic veins to the liver. One of these disappears later, and only the left persists as the umbilical vein till birth, when that also becomes obliterated. The suspensory ligament is finally derived from that portion of the ventral alimentary mesentery which is between the liver and the anterior body wall. That portion between the liver and the stomach and duodenum (*i.e.* dorsal to the liver) becomes the gastro-hepatic omentum. The vascular arrangement in the liver develops in man somewhat differently from the course in most other mammals. It must be remembered that at one time three pairs of veins are emptying into the sinus venosus of the heart—(*a*) the *Cuvierian,* returning blood from the embryo itself; (*b*) the *vitelline,* returning the blood from the yolk sac; and (*c*) the *allantoic,* returning blood from the placenta. The Cuvierian veins have no special significance as regards the liver. It is, however, necessary to follow out the changes in the other two pairs. The vitelline veins are closely associated with the liver, and become lost in it as development proceeds. Early in the fourth week these veins become interrupted in their course through the liver by the establishment of a set of capillaries. In this way are formed veins supplying blood to the liver substance and conducting blood from the liver substance. These are the *venæ advehentes* and the *venæ revehentes.* The right and left vitelline veins become connected by three commissural vessels just before they enter the liver, one of these being dorsal to the gut, and the other two ventral. Two vascular rings or *sinus annulares* are thus formed. The afferent hepatic vessels arise from the upper of these rings. The right and left vitelline veins later unite to form a single vein, and connected with this vein are vessels bringing blood from the intestine, and thus the portal vein originates. With respect to the two annular sinuses, the left half of the upper and the right half of the lower become obliterated; a single vessel thus becomes formed, having a spiral course round the gut. The allantoic veins during the fourth week lose their connection with the sinus venosus. The only important remnant of these is the left allantoic vein, which joins the upper sinus annularis as this is breaking up in the liver substance. At a certain stage in the human embryo, at about the twenty-third day, the blood returning to the heart by the vitelline and allantoic veins must necessarily pass through the capillaries of the liver. But, later, a direct passage to the heart becomes formed between the developed portal vein, just as this is breaking up into the liver substance, and the right hepatic vein (the proximal portion of the right vitelline vein). This is known as the *ductus venosus* or *vena aurantii.* This appears to be a new vessel in the human embryo, though in the rabbit it corresponds to a portion of the paired vitelline veins. The left hepatic vein subsequently loses its direct connection with the heart, and a new communication with the sinus venosus becomes established. The posterior vena cava develops later by joining the sinus venosus. This is formed by the junction of the iliac veins, and is at first quite insignificant. During fœtal life, therefore, the blood which has come to the liver by the umbilical vein has two alternative routes open to it. A part may go by the afferent hepatic vessels through the substance of the liver, the larger part goes direct through the ductus venosus to the heart. The ductus venosus disappears at birth with the obliteration of the umbilical vein. The blood passes to the liver by the portal vein only, and is able to reach the heart only by traversing the substance of the liver. The umbilical vein and the ductus venosus are generally obliterated by the sixth or seventh day.

## THE STRUCTURE OF THE LIVER.

The mammalian liver at first sight bears but little resemblance to the usual plan upon which a gland is arranged.

In lower animals the typical glandular arrangement is more apparent, and in its early development, even in the mammal, it is more easily seen. The reason for the departure from the typical form is probably to be found in the fact that with higher animals the functions of the organ have become modified, so that its primitive function of the secretion of bile becomes less conspicuous, and its adaptation to that function alone less obvious.

In the frog, and to some extent in the mammalian embryo, we find a simple tubular liver, consisting of cells arranged around a lumen, into which is poured the secretion of those cells. The liver of such an animal may be aptly compared to the secretory portion of the mammalian pancreas, and betrays apparently more resemblance to this than to the mammalian liver. The fundamental difference, however, between the liver of the amphibian and the mammal lies in the fact that the lumen into which the bile is secreted is in the latter a mere chink between two hepatic cells, whereas in the former it is a definite passage bounded by many hepatic cells. These narrow passages are called bile capillaries, and they show considerable anastomosis. This, however, is also the case in the simple tubular liver of the amphibian.

The cells of the mammalian liver are massed into lobules. They have a definite arrangement in these lobules, being disposed as rods or columns of cells, set in a radial manner from the centre of the mass. Between the columns, blood vessels pass from the periphery towards the centre. Between the cells also, there are the narrow passages forming the bile capillaries, which anastomose freely, but pass the bile to the periphery of the lobule, where it is received in larger vessels, the bile ducts. The lobules are sometimes definitely separated from one another by septa of areolar tissue, continuous with the external fibrous covering of the liver. This occurs in the pig and the camel. In the rabbit the lobules are not so definitely bounded, in man they are even more confluent.

Around the lobule are numerous blood vessels. These are either branches of the portal vein, branches of the hepatic vein, or branches of the hepatic artery. The branches of the portal vein and hepatic artery, as they ramify through the organ, receive together with the bile ducts a loose but strong sheath of areolar tissue, enclosing the three vessels together, and forming what are termed *portal canals.* This capsule of areolar tissue is frequently called *Glisson's capsule.* The hepatic veins are invested by a small amount of areolar tissue, which binds them to the glandular substance, and prevents their collapsing after becoming empty. These have been called *hepatic canals.* In the loose areolar tissue investing the vessels are numerous lymphatics. From the branches of the portal vein, as they ramify around the lobules, being then called *interlobular veins,* numerous vessels proceed gradually between the columns of hepatic cells towards the centre of the lobule, or towards one particular radius, along which the efferent vein of the lobule conducts the blood. The finer lobular vessels anastomose, and form a capillary network in the lobule, the distance apart of two adjacent capillaries being no greater than the diameter of two liver cells. The capillary vessels themselves are comparatively

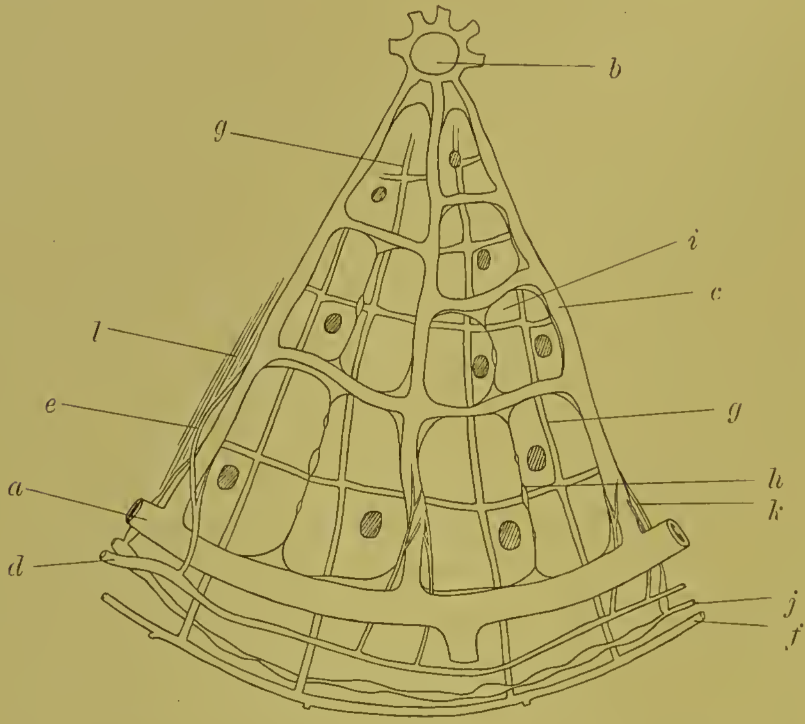

FIG. 9.—Diagrammatic section of a lobule of the liver. *a*, interlobular vein; *b*, intralobular vein; *c*, intralobular capillaries; *d*, interlobular artery; *e*, branches of interlobular artery; *f*, interlobular biliary canal; *g*, branches of biliary canal in the lobule, forming the intercellular canaliculi; *h*, biliary canaliculi in transverse section; *i*, hepatic cells; *j*, interlobular lymphatic vessels; *k*, intralobular lymphatic vessels; *l*, intralobular connective tissue. (After TESTUT.)

large. The central vessel into which the blood is poured is called the *intralobular vein*, and proceeds along one of the radii of the compressed sphere to which the lobule may be compared, to a vein at the periphery of the lobule called the *sublobular vein*. The sublobular veins, by confluence, gradually form the larger branches of the hepatic veins.

The hepatic artery finally terminates in three sets of vessels, entitled the vaginal, capsular, and interlobular. The first supply the portal canals, the second spread out in the fibrous coat on the surface of the liver, the last supply blood to the walls of the interlobular veins and bile ducts, and possibly to the extreme peripheral parts of the lobule.

The hepatic cells are polyhedral in form, and have a diameter varying from ·017 mm. to ·022 mm. They have no cell membrane. They frequently contain granules in their cell substance. The nuclei are round and clear, and have generally one or two nucleoli. After fatty diet the cells may be found to contain fat, more conspicuously seen in those cells near the periphery of the lobule.

The cells frequently contain glycogen, and after the glycogen is dissolved out the cell may show a vacuolated appearance. In the frog, where one aspect of the cell is connected with the blood supply and another with the bile capillary, it is easy to make out that the glycogen is laid down in that part of the cell nearest the blood supply. In the mammal this is not so easily shown, as the same face of the cell may be in one part connected with the bile capillary and in another with the blood vessels, but the irregularity seen after dissolving out the glycogen probably depends upon the same arrangement.

The bile capillaries between the cells can be demonstrated, either by the silver-chromate method, or by killing the animal, an appropriate time after the administration of sulphindigotate of soda. They are probably channels grooved out between the cells, as far as their origin is concerned, and possibly have connection, at certain times, with other vacuoles which form within the cells.

The bile ducts, as observed between the lobules, have walls composed of a fine fibrous tissue, with a lining of columnar epithelium. They have both longitudinally and circularly disposed muscle fibre in their walls. In the bile ducts of intermediate size numerous openings are to be observed, but these are the mouths of simple tubular recesses rather than of glands. In the larger bile ducts a considerable amount of elastic tissue occurs, and in the main ducts mucous glands are to be found.

The gall bladder possesses a peritoneal investment, a muscular and connective tissue coat of much strength, and a mucous lining. This is found, after death, elevated into numerous ridges with corresponding depressions (Fig. 7). The whole is covered by columnar epithelium, and mucous glands are present in the walls. The hepatic duct, the cystic duct, and the common bile duct, have the ordinary characters of the larger bile ducts.

The nerves of the liver, derived mainly from the left pneumogastric and the solar plexus, are described as terminating in fine arborisations, and distributed to the walls of the blood vessels and biliary ducts, and also between the hepatic cells. It is also said that such medullated nerves as enter the liver are distributed to the liver cells, whilst the non-medullated supply almost exclusively the blood vessels.

The "aberrant ducts," described by Ferrein, and later by Kiernan, represent portions of liver which were of importance at an earlier period of development, but which have since undergone atrophy.

# CHAPTER II.

## THE FUNCTIONS OF THE LIVER.

THOUGH in earlier times, from its connection with a disordered state of the body, the secretion of bile was considered *the* function of the liver, at the present day we are disposed to consider the formation of bile as less important than other functions. Probably of greater importance to the animal body is the influence the liver brings to bear upon carbohydrate foods, upon proteid foods, and upon the formation of substances excreted in the urine. Of much importance, also, is this organ in changing such substances as probably result from muscular metabolism; and in proportion to its metabolic activity and absolute bulk its relation to the heat formation of the animal body must be duly estimated. Though the bile, then, is to be looked upon as a "comparatively insignificant bye-product," its formation may be conveniently considered before other functions of the liver.

*The secretion of bile by the liver.*—Though, in general, the rate of secretion of a gland depends upon the demand made periodically for the secretions, yet in the case of the liver we have a secretion of bile which is continuous, though subject to alteration of rate influenced by the progress of digestion in the alimentary canal. We can in this sense compare the secretion of bile rather with the secretion of the kidney than with that of other glands opening into the alimentary canal. As, however, the constant inflow of bile to the alimentary canal might be somewhat harmful to the organism, we have (at any rate in carnivora) an apparatus in which the bile secreted in the intervals of digestion may be conveniently stored. The quantity of bile secreted by man has been estimated in cases of biliary fistulæ, some of which, however, occurred in patients so far removed from the normal condition as to make any exact conclusion drawn from them extremely hazardous. Nevertheless, other cases, though permitting observation by reason of the fact that a biliary fistula existed, yet showed the patients to possess, in the main, all the signs of health, so that deductions as to the absolutely normal condition of the secretion of bile might be made without any large error being included.

Such a case is that recorded by Copeman and Winston,[1] in 1889. Here occlusion of the common duct, due to a calculus, existed, the patient showing the usual symptoms of jaundice. The gall bladder was opened, and a fistula resulted, through which the whole of the bile formed was passed. The jaundice gradually disappeared, the urine lost its bile reaction, but the stools remained greyish and free from bile. This case, then, affords an example of the way in which the possible purposes of the formation of bile might be separated. As far as bile constitutes a discharge of waste material, its function was not interfered with, but any powers it possesses of influencing digestion were lost.

From the observations of Copeman and Winston it was found that the quantity of bile secreted in twenty-four hours averaged 779·6 c.c. This agrees fairly closely with a series of observations made about the same time on a patient of Mayo Robson,[2] in which the quantity was found to average 850 c.c. in twenty-four hours. In the first case the solids per diem were 11·09 grms.; in the second, 15·28 grms.

As regards variation in the rate of secretion, it seems that there is an increase soon after a meal is taken, then a diminution, followed by a subsequent minor increase.

We proceed next to a consideration of the different influences which affect the secretion of bile. The first question that may be asked is, How far does the absorption of bile in the intestine influence the further secretion?

It was pointed out by Schiff[3] that withdrawal of bile leads to a diminution in the secretion, but if bile be allowed to flow into the intestine the secretion is increased again. From this he argued that a portion of the secretion absorbed in the intestine furnishes material for further secretion. This has been confirmed by Prévost and Binet,[4] and Wertheimer,[5] who, on injecting foreign bile into the blood vessels or into the stomach of an animal, found the characters of the foreign bile in the secretion of the animal. It seems, therefore, possible that the secretion of bile depends to some extent upon absorption from the alimentary canal, and thus a kind of circulation of biliary constituents occurs.

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[1] Copeman and Winston, *Journ. Anat. and Physiol.*, London, vol. ix. p. 213 *et seq.*

[2] Mayo Robson, *Proc. Roy. Soc. London*, vol. xlvii. p. 499 *et seq.*

[3] Schiff, *Arch. f. d. ges. Physiol.*, Bonn, 1870, iii. s. 598.

[4] Prévost and Binet, *Rev. méd. de la Suisse Rom.*, Genève, 1888, No. 520.

[5] Wertheimer, *Arch. de physiol., norm. et path.*, Paris, 1891, pp. 724 *et seq.*

The next question that arises is, How far does the secretion of bile depend upon the circulation of blood through the liver?

Cases have been cited, such as those of Abernethy,[1] in which the portal vein opened into the vena cava inferior below the liver, yet the secretion of bile was not apparently interfered with. Experimentally, the portal vein has been ligatured, and a connection made between the vena cava inferior and the portal vein. Here no arrest of secretion of bile was observed. We may suppose, therefore, that in cases of occlusion of the portal vein, the hepatic artery can supply the liver with the essentials for the formation of bile.

Finally, with respect to the influence of the nervous system upon the secretion of bile, a general fall of blood pressure, brought about by nervous agencies, affects the secretion of bile adversely. Section of the splanchnic nerves, causing a dilatation of the blood vessels of the abdominal area, also causes an increase in flow of bile. We have evidence, then, that the secretion of bile depends, within limits, upon the blood flow through the liver, but at present we are without evidence as to any direct central or local nervous mechanism affecting the secretion of bile.

The pressure of the secretion of bile, though low as compared with that of saliva, yet is higher than that of the portal vein.

If the outflow of bile be prevented, the secretion becomes reabsorbed, and the constituents, or at any rate the pigments, are excreted by the urine. The fact that the bile salts are not invariably associated with the pigments in icteric urine, suggest that they are not so conspicuously waste substances as the latter are. The reabsorption of the bile that occurs is through the medium of the lymphatics with which the liver is plentifully supplied.

*The composition of the bile.*—The composition of bile, as obtained from the cases of biliary fistulæ previously referred to, does not show any great variation.

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[1] Abernethy, *Phil. Trans.*, London, 1793, p. 61.

One example may therefore be taken as indicative of the several observations.

| | | |
|---|---|---|
| Water | | 98·474 per cent. |
| Solids:— | | |
| Glycocholate of soda | ·349 | |
| Taurocholate of soda | | |
| Soaps | | |
| Cholesterin | ·075 | |
| Lecithin | | |
| Fats | | |
| Mucinoid matter, pigments, etc. | ·461 | |
| Inorganic salts | ·641 | |
| | | 1·526 ,, |
| | | 100·000 ,, |

The characters and significance of these constituents require some comment.

The bile of all animals contains either glycocholic or taurocholic acid, or both. In herbivora, glycocholic acid is the more important; in carnivora, taurocholic acid. In man, glycocholic acid is predominant; taurocholic acid being frequently absent.

The bile salts may be prepared as follows in the form of Platner's "Crystallised Bile." The bile is mixed with animal charcoal, and evaporated to dryness in a water bath. When completely dry, an extract is made with absolute alcohol. To this extract anhydrous ether is added, and a white amorphous precipitate forms, which after a day or so shows masses of crystals. These crystals are the salts of glycocholic and taurocholic acids.

These two acids are recognised by means of Pettenkofer's reaction. The solution supposed to contain the acid is freed from albuminous matter, and a few drops of a strong solution of cane sugar are added, and the mixture well shaken. Strong sulphuric acid is added, drop by drop, and a purple colour is developed. It has been shown that this reaction depends upon the formation of furfurol, and Mylius modifies the test by substituting a solution of furfurol for cane sugar. In connection with Pettenkofer's reaction, it must be remembered that other substances besides bile salts give a somewhat similar result with the reagents used in the test. To completely identify the bile salts, it is necessary to confirm by means of spectroscopic examination of the colour produced in the Pettenkofer reaction. Two marked absorption bands occur if bile salts are present, the centres of the bands corresponding to λ527 and λ487.

With respect to the nature of these bodies, by decomposition glycocholic acid yields cholalic acid and glycin (amido-acetic acid), whilst taurocholic acid yields cholalic acid and taurin, this latter being a sulphur-containing body.

The colouring matters of bile attracted attention for obvious reasons earlier than the other constituents. In the commencement of the present century, Gmelin pointed out the effect of nitric acid in producing changes in the colour of bile.

To the pigment causing the orange or golden-yellow colour of the bile of man and carnivorous animals the name *bilirubin* has been applied. It is also found in the blood serum of the horse, in gall stones, and in old blood extravasation it exists as microscopic crystals, to which the name of hæmatoidin was applied by Virchow. Biliverdin imparts the green colour to the bile of herbivorous animals, and it is presumably identical with the green pigment obtained by the action of oxidising reagents on bilirubin.

The presence of these pigments is usually ascertained by means of nitric and nitrous acids (Gmelin's reaction). If such acid be allowed to come into contact, avoiding mixing, with the solution of the pigments, a series of colours will be seen. In the case of bilirubin, zones of green, blue, violet, red, and reddish yellow will be seen in order, the latter being nearest the acid. To be certain that the pigment is really a bile pigment, the whole series of colours must be seen, or the colour change examined spectroscopically. The substances formed giving the reddish yellow colour and constituting the last of the oxidation changes, have applied to them the single name *choletelin.*

There are also certain chromogens existing in the bile of some herbivora, which, under the influence of the decomposition occurring when the bile is exposed to the air, yield pigments with well-marked absorption spectra. Such a body is *cholohæmatin*, obtained from the bile of oxen and sheep.

The mucinoid substance of bile demands a brief reference. In the ox the so-called mucin is mainly nucleo-proteid; in human bile there is very little nucleo-proteid and a large amount of mucin.

The cholesterin that occurs in bile may be looked upon as the excess separated from the blood, which has arisen from metabolic changes in nervous tissues.

Finally, as far as the composition of bile is concerned, it must not be lost sight of that iron is a constant constituent.

*The origin of the bile acid.*—Glycin and taurin probably arise from proteid metabolism in the body generally. Yet they by no means represent the entire amount of the proteid decomposition that occurs. An increase in the supply of proteid food to an animal does not proportionately increase the nitrogen and sulphur of the bile. The cholalic acid which unites with these bodies is probably furnished by the liver cells, but the nature of the process whereby this is brought about we are ignorant of. We do not know why taurocholic acid is predominant in the bile of one animal, whilst glycocholic is of greater importance in another. It may, however, be pointed out that, agreeable to the larger consumption of proteids in the carnivorous animal, we have taurocholic acid which contains sulphur, as would naturally be expected. Nevertheless, the glycin also is a product of proteid decomposition.

*The origin of the bile pigments.*—Virchow, about 1850, pointed out the resemblance of the hæmatoidin found by him in old blood clots to the bile pigment. Precise experiments have been performed often since then, all tending to prove the change of blood pigments into bile pigments. Moreover, the formulæ of hæmatin and bilirubin have a very close relationship, and hæmatin deprived of its iron (hæmatoporphyrin) is apparently of the same percentage composition as bilirubin.

Amongst vertebrates, *Amphioxus* alone does not possess red blood, and forms no bile-colouring matters. If the hæmoglobin becomes changed into bilirubin, the iron element must be separated before bilirubin is formed. This is found to be the case; the liver cells contain iron in combination, and in excessive destruction of red corpuscles the iron is present in large quantity in the liver.

*The nature of jaundice.*—We now look upon jaundice as invariably produced by causes which obstruct the outflow of bile, or in some way modify the pressure under which it passes along the bile ducts. The bile in these cases is partially reabsorbed by the lymphatics, passed to the thoracic duct, and thence into the blood. If the amount is such that the kidneys cannot secrete it entirely, it is found staining the tissues and giving the characteristic colour to the skin. That the bile is reabsorbed from the bile ducts in this manner, is proved by simultaneously ligaturing both the common bile duct and the thoracic duct. It is then found that the bile pigments no longer colour the urine, and no jaundice is obvious.

In earlier days it was thought that the liver acted rather as a separator than as a producer of the bile. It was thought that two forms of jaundice could occur, the jaundice from suppression of the liver function in separating, and the jaundice from obstruction of the outflow of bile from the liver. But it has now been conclusively proved that if the liver be extirpated, or rendered functionless by isolation, no accumulation of biliary constituents results.

From researches of Kühne and others, about 1860, it was thought that jaundice could have a double origin, that there could be a *hæmatogenic* as well as a *hepatogenic* jaundice. The injection of blood pigments into the circulation caused at one time the presence of hæmoglobin in the urine, at another of bilirubin. The latter resulted if a bile acid was simultaneously injected. It was necessary to see whether this change of hæmoglobin into bilirubrin really occurred in the blood. The evidence adduced by many observers was, however, in favour of the change occurring actually in the liver. The experiments of Minkowski and Naunyn practically settled this question. Inhalation of arseniuretted hydrogen causes the appearance of bile-colouring matters in the urine in ducks and geese. If the liver were isolated by ligature, hæmoglobin was found replacing the bile pigment. In order that bile pigment should be produced, the hæmoglobin set free in the blood by the action of arseniuretted hydrogen must be acted on by the liver. If not so acted on, it appears as simply blood pigment. All the evidence, indeed, tends to indicate that there is no such occurrence as hæmatogenic jaundice.

*The modification of bile in abnormal conditions.*—After the administration of certain drugs, phenylhydrazin, toluylenediamin, pyrogallol, etc., oxyhæmaglobin may occur in the bile. This seems to depend upon insufficient elimination by the kidneys. In obstructed venous circulation, albumin may be found in the bile. Sugar occurs in diabetes, urea is frequently found after death in the bile, when Bright's disease or cholera have proved fatal. Leucin and tyrosin have been found after death from acute yellow atrophy.

In pyrexia the quantity of bile is diminished, and the bile pigments may be so much diminished as to leave the bile practically colourless. This has been noticed to occur during that part of the day when the temperature was highest.

Occasionally a calculus may be impacted in the cystic duct, and acting as a valve may permit of the exit but not of the entrance of fluid into the gall bladder. A fluid may then be passed from the gall bladder, which is colourless, highly viscous, and of alkaline reaction. It is a secretion of the gall bladder. A calculus may completely occlude the gall bladder, which then becomes distended, sometimes enormously, by such a fluid, causing the so-called dropsy of the gall bladder, or *hydrops cystidis felleæ.* We must not, however, regard this as a normal secretion of the gall bladder.

*Cholagogues.*—It has been long known clinically that certain drugs cause an increase in the amount of bile secreted. Rutherford investigated this question very elaborately. He found that many drugs might be classed as "hepatic stimulants." Amongst the more powerful of these are sodium phosphate, mercuric chloride, ipecacuanha, colchicum, jalap, aloes, colocynth, sodium benzoate, and salicylate; much feebler are rhubarb, nitro-hydrochloric acid. Some investigators have denied that any true cholagogic action is to be ascribed to these drugs. Positive results have, however, been attained by Rosenberg, who said that olive, oil, bile and sodium salicylate, were true cholagogues. Santonin is also said to be of this character. The great flaw in Rutherford's experiments, and in those of many others, lies in the fact that the bile had been entirely diverted from the intestinal canal, and thus the re-absorption of some of the constituents which normally occurs was prevented, and thus an abnormal condition of the animal ensued.

To whatever extent the secretion of the bile may be affected by the administration of certain drugs, there is no doubt that the bile may act as a vehicle for the elimination of certain metallic poisons. But as long as the hepatic membranes are complete and impervious, probably even when the blood is teeming with micro-organisms, none of these will pass into the biliary secretion.

*The glycogenic function of the liver.*—There seems little doubt that a large proportion of the carbohydrate material of food is not made use of immediately in the body, but that, passing by the portal vessels to the liver as dextrose, it is stored up in the hepatic cells as glycogen, to be drawn upon as required by the animal. A hot-water extract, made from the liver of an animal immediately after death, contains a large quantity of glycogen; similar extracts made some hours after death contain no glycogen, but sugar. Apparently, therefore, the glycogen is not in a stable condition, but is easily changed in the body into sugar.

After much hard work, an animal is found to have but a small amount of glycogen in its liver, unless at the same time it is plentifully fed; and this food need not necessarily be carbohydrate, proteid food will also result in glycogen being stored. We may say that the great weight of evidence is that glycogen leaves the liver as sugar, though it is at the same time possible that some proportion may pass out in other combinations.

*The formation of urea in the liver.*—It is not possible to trace the urea present in the urine, from any other important source than the liver. It is probable that not only is the excess of nitrogenous food passed out from the liver as urea, but also that the nitrogenous waste derived from various parts of the body receive, by the metabolic activity of the liver, a final fashioning into urea.

If an excised liver have passed through it, under appropriate conditions, ammonium carbonate, urea is formed. This is not the case if it be passed through the kidney or the muscles.

If blood from an animal killed in digestion be passed through the liver, urea is found, and this cannot be referred to washing out urea from the liver. In acute yellow atrophy of the liver, urea may be replaced by leucin and tyrosin in the urine.

Though one cannot give the stages passed through by proteids towards urea with any definiteness, yet there seems little doubt that the changes that occur in this direction take place largely in the liver.

# CHAPTER III.

## JAUNDICE.

JAUNDICE is essentially a symptom of a disease or diseases, and is not a disease itself. It occurs in the course of many hepatic and biliary affections, as well as in diseases which primarily and chiefly involve organs other than the liver and the biliary system. Jaundice can be defined as a condition or state in which bile-colouring matters are present in the urinary excretion, and the conjunctivæ, skin, and mucous membranes are stained a more or less pronounced yellow, brownish yellow, or greenish yellow, by the deposit in their tissues of the biliary pigments.

*Pathology of jaundice.*—According to the results of a number of recent researches concerning the pathology of jaundice, it appears to be quite clear that the symptom is due in every case to the presence of an obstruction, partial or complete, to the flow of the bile along the intra- or extra-hepatic bile ducts. It has already been stated that the bile pigments are physiological derivatives of the pigment of the blood, that is to say of hæmoglobin; and by some authorities it is said that the pigment of the blood can be transformed into bile-colouring matter by organs other than the liver. This being assumed, it was supposed that a hæmatogenous variety of jaundice could be produced, owing to the formation of the bile-colouring matter in some part of the circulatory system from the blood pigment. This view of the pathology of jaundice has been shown to be incorrect by the recent experiments of Fleischl,[1] Kunkel,[2] Kufferath,[3] and Vaughan Harley.[4] Thus it has been demonstrated conclusively by these experimenters that no jaundice results if the common bile duct and the thoracic duct of an animal be simultaneously ligatured. The work of

[1] Fleischl, *Arb. a. d. physiol. Anst. zu Leipzig*, 1874, s. 24.

[2] Kunkel, *ibid.*, 1875, s. 112.

[3] Kufferath, *Arch. f. Physiol.*, Leipzig, 1880, s. 92.

[4] Vaughan Harley, *ibid.*, 1893, s. 29.

Vaughan Harley upon this subject has clearly shown that the above view is the only correct one. Minkowski and Naunyn[1] have isolated the liver in birds by the application of ligatures to the hepatic vessels and duct, and they have afterwards examined the blood of the animal experimented upon, but in no case have they been able to demonstrate the existence of any of the biliary pigments in the blood. The statement that the bile pigments are formed only in the liver, is supported clinically by a case which has been observed and recorded by Hanot and Gombault. The patient was a man who suffered from a chronic peritonitis, and in whom the common bile duct and the vessels in the portal fissure were slowly and gradually obliterated, owing to the inflammatory process. The secretion of bile gradually diminished as the obstruction to the circulation increased, until finally the production of bile pigment ceased. From these considerations it appears to be certain that the mechanism of the production of jaundice is as follows: an obstruction arises which impedes, retards, or arrests the flow of bile along some portion of the biliary ducts, and as a result the bile is secreted at a higher pressure than normal. Next, the bile passes from the intra-hepatic bile vessels into the small lymphatic vessels which lie in the immediate neighbourhood of the bile capillaries, whence it is carried into the larger lymphatic channels in the liver, and from these into the thoracic duct and the general blood system. By the blood stream the colouring matter is carried to the tissues of the body generally; when it reaches the kidneys part of it is excreted by these organs and hence it is voided in the urine, whilst a portion is deposited in the tissues, this deposit occurring first in the conjunctivæ and next in the skin. The first signs of jaundice are the presence of bile pigments in the urine, next pigmentation of the conjunctivæ and skin, and last of all deposit of pigment in the tissues generally. White fibrous tissue appears to be the commonest tissue to be stained, whilst the teeth, hair, cartilage, and the central nervous system do not become a seat of the deposit of the pigment. Exudations from serous surfaces, such as ascitic fluid and the fluid which is found in the peritoneum, pleura, and arachnoid, are usually stained with the bile pigment. The physiological secretions of the salivary and lachrymal glands do not contain any bile-colouring matter during an attack of jaundice. The secretion of the mammary gland during lactation may be stained yellow, owing to the presence of bile pigments; this, however, is not constant, and it has only occasionally been observed. The secretion of the sweat glands becomes stained with the pigments during an attack of jaundice. In order to allow the development of jaundice as a result of biliary obstruction, it is requisite that the hepatic cells should by their activity produce bile which contains the ordinary pigments.

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[1] Minkowski and Naunyn, *Arch. f. exper. Path. u. Pharmakol.*, Leipzig, Bd. xxi. s. 1 *et seq.*

*Causes of jaundice.*—The morbid processes which may be the cause of an attack of jaundice are rather numerous. They act directly in some cases and in others indirectly, but in all it will be found that a condition of obstruction to the flow of bile along the ducts has been induced. These morbid processes may affect the lumen of the biliary channel alone, or they involve the tissues which form its walls, or they may be seated for the most part in the anatomical structures which lie in the immediate neighbourhood of the ducts. In the first group we shall include gall stones, parasites, and foreign bodies, which have gained an entrance into the bile channels. When a gall stone is the cause, it will usually be found to have become impacted in some part of the common bile duct, or in the common hepatic duct. In the majority of cases gall stones take their origin in the gall bladder, and as long as they remain in this sac they do not produce biliary obstruction, except under exceptional conditions, to which we shall refer later. When they are expelled from the gall bladder, they pass along the cystic duct, and thence into the common bile duct. The stone may be arrested in some portion of the cystic duct, and when this occurs it may or may not result in jaundice, according to the amount of interference which is produced in the flow of the bile along the common bile duct. The flow of bile along the common bile duct is not usually affected in these cases. When the calculus has passed into the common bile duct, it may either pass along this canal into the duodenum, or it may be arrested in some part of its course. The most common place for it to be arrested is the portion of the duct immediately above its entrance into the duodenum, since at this point the lumen of the duct is narrower than at any other part. It is not, however, uncommon to find the calculus arrested at other points, especially in the gastro-hepatic omentum. In rare cases, the calculus, after it has passed from the cystic duct into the common bile duct, slips backwards along the common hepatic duct and is arrested in some part of this canal. When a calculus has been arrested, either in the common hepatic duct or the common bile duct, it usually produces complete obstruction to the flow of bile. This is effected partially by the mechanical obstruction of the calculus itself, and partially by the swelling of the mucous lining of the duct, owing to the irritation of the calculus. If a calculus remains impacted at the same spot for a considerable period, it commonly sets up a condition of local ulceration, which ulceration may at a later stage, when the calculus has passed into the intestinal canal, be followed by cicatrisation and subsequent narrowing or closure of the lumen of the duct. An attack of jaundice which is due to gall stones, is usually sudden in its onset, and is preceded by one or more attacks of biliary colic. Parasites are an occasional cause of jaundice. Distomata, ascarides, and echinococcus cysts have been met with in the bile ducts as causes of obstruction. Distomata usually inhabit the portal vein as it lies within the liver, but they have been known to work their way through the walls of this vessel and gain an entrance into one of the large bile ducts, and so become a cause of mechanical obstruction to the passage of bile. Cases have been recorded in which ascarides have passed from the intestine through the aperture of the common bile duct (where it opens into the duodenum), into the lumen of the common bile duct, and there, becoming coiled up, they have produced sudden and complete obstruction, which has been followed by an attack of jaundice. It is very uncommon for round worms to become impacted in this manner. When the liver is the seat of a hydatid cyst, it occasionally happens that this cyst ruptures, and one or more of the daughter cysts pass into one of the intrahepatic bile ducts and then pass along into the common bile duct, where they become rolled up and cause mechanical obstruction. As the cyst passes along the bile duct it gives rise to an attack of biliary colic, which resembles that which is due to the passage of a gall stone. Foreign bodies, such as the seeds of fruit, have been known to pass from the duodenum into the common bile duct, and there they have become impacted, causing obstruction to the passage of bile into the duodenum.

In the second group of the pathological causes of jaundice, are included those morbid processes which involve the tissues forming the walls of the ducts themselves. The commonest is an inflammatory condition of the mucous membrane which lines the internal surface of the ducts. In the majority of cases the inflammatory process spreads by direct continuity from the mucous membrane of the duodenum, and it is often associated with a gastro-intestinal catarrh. The inflammation is either catarrhal or suppurative, usually the former. The inflammatory process causes a swelling of the mucous membrane, which may be so extensive as to obliterate the lumen of the biliary canal, and hence induce jaundice by obstruction. This condition is one of the common causes of jaundice, both in adults and in infants. Stenosis of some portion of the common bile duct or common hepatic duct, may be a cause of jaundice. The stenosis may be either congenital or acquired in its origin. When it is congenital there may be complete obliteration of a portion of the common bile duct or the common hepatic duct. Most commonly that part immediately above the duodenum is not patent. The different varieties of congenital closure of the bile ducts are described in the chapter upon malformations. When the stenosis is of acquired origin it is most commonly due to the contraction of a scar which has been left by a previous condition of ulceration. The ulcer in some cases is caused by the irritation of a calculus which has been lodged there, or it may follow a purulent catarrhal condition of the mucous membrane, or it may be the result of syphilis, a gumma having developed in the wall of the bile canal, and healed leaving a fibrous scar. Tumours may grow from the tissues which form the walls of the ducts, and when these extend in an inward direction they obliterate, partially or completely, the lumen of the affected portion of the duct. These tumours may be innocent or malignant in nature. Among the innocent ones, fibromata, lipomata, papillomata, and gummata have been met with. These innocent growths are, however, exceedingly rare. The malignant formations are either carcinomata or sarcomata, the former being the more common. Jaundice, which is due to the presence of a tumour, is usually gradual in its onset, and persists.

The third group comprises a number of very different morbid conditions. Chronic inflammatory processes which are located in the neighbourhood of the bile ducts, may extend and involve them, giving rise to the formation of cicatricial tissue, which will contract and so cause diminution in the size of the lumen of the biliary canal, and by this means bring about a biliary obstruction. Duodenal or gastric ulcers which have perforated the walls of the alimentary canal, and set up a localised perihepatitis, may be the cause of the production of scar tissue, which at a later period contracts and causes an obstruction to the flow of bile. A duodenal ulcer, which involves the mucous membrane in the immediate neighbourhood of the opening of the common bile duct into the intestines, may heal, and the scar which results contract and cause stenosis of the biliary canal as it passes through the wall of the duodenum. An inflammatory process around the portal vein as it lies in the gastro-hepatic omentum, or in the portal fissure, is liable to be followed by the formation of scar tissue, which may cause narrowing of the adjacent portion of the bile ducts, and in this manner set up jaundice owing to the establishment of an obstruction to the bile stream. Hydatid cysts of the liver or hepatic region can, by direct pressure, obliterate the lumen of the bile ducts, either partially or completely, and thus cause biliary obstruction. In a similar manner an aneurism of the hepatic artery, of the neighbouring portion of the abdominal aorta, or of the superior mesenteric artery, may by pressure from without establish biliary obstruction and cause subsequent jaundice. Tumours, such as carcinomata of the gall bladder, duodenum, and the head of the pancreas, frequently involve the common bile duct by a direct extension of the morbid process, and cause partial or complete obliteration of its canal, jaundice following as a result of this obstruction. In rarer cases, malignant growths, which may be primary or secondary, of the colon, kidneys (especially the right), uterus, ovaries, omentum, mesentery, or portal lymphatic glands, are the cause of biliary obstruction, owing to pressure from without.

The intra-hepatic affections which cause obstruction to the flow of bile along the bile ducts within the liver may be divided into three groups, in the same manner as the extra-hepatic affections. Thus intra-hepatic calculi, which may have been formed originally within the liver, or which have migrated from the gall bladder into an intra-hepatic bile duct, can cause obstruction, whilst a distoma or a mass of inspissated bile may act in a similar manner. Jaundice from these causes is not very common, since only one of the smaller ducts is involved, and this is not sufficient in most cases to set up this condition. The mucous membrane which lines the internal surface of the bile ducts within the liver may be the seat of a catarrhal or suppurative inflammatory affection, which is due to the extension of a similar process from the extra-hepatic ducts. This affection results in the development of a catarrhal jaundice, but it only occurs in association with a like condition of the larger ducts outside the liver. Inflammatory processes in the interior of the liver, which are either interstitial, parenchymatous, syphilitic, tubercular, or suppurative, by exerting pressure upon the bile ducts from without, can produce an obstruction to the free flow of bile, and in this manner may be the cause of an attack of jaundice. In a like manner, new growths, as carcinomata and sarcomata, can give rise to jaundice, but these cases are not very common.

*The symptoms of jaundice.*—At a very early period after the obstruction to the free flow of bile along the biliary ducts has been established, the urine becomes darker in colour than is usual, owing to the presence of bile pigment. Pigment is said to be present after the expiration of three hours, if the common bile duct of a dog is ligatured. Wickham Legg[1] made a similar experiment on cats, and found that a much longer time was required before there were distinct signs of pigment in the urine. He says that a pigment is very often present in the urine of dogs under quite normal conditions, which it is impossible to distinguish from bilirubin, by Gmelin's test; and on these grounds he throws doubts on the statement that the pigment appears in the urine at the end of three hours. In man it is not possible to say how soon the pigment appears in the urine, after obstruction has taken place. Clinically, the presence of bile pigments—that is to say, bilirubin in the urine—is sought for by the application of Gmelin's test. In applying this, a plate of white porcelain is taken, and upon it a small quantity of the suspected urine is placed, and to it is added a few drops of fuming nitric acid (nitric and nitrous acids mixed); if any bilirubin is present, a play of colours is produced where the liquids come into contact. Another test for bile pigments, which is easy of application, is Maréchal's test. A mixture of tincture of iodine and alcohol, in the proportion of one part of the former to ten of the latter, is added to the urine which is supposed to contain bile, and if any bile pigments are present a greenish-coloured ring will be seen where the two liquids come into contact. After the urine, the conjunctivæ next become stained with the bile pigment. This coloration apparently comes on within twenty-four to forty-eight hours after the obstruction has commenced. In man, however, it is very difficult to say when the obstruction docs commence. This coloration is usually the first symptom of jaundice which is noticed by the patient or his friends. The skin is the next tissue which becomes stained, the coloration usually commencing in the face and extending thence to the neck; afterwards, the upper extremities and upper portion of the trunk are stained; and, lastly, the lower portion of the trunk and the lower extremities. This staining of the skin is more apparent, especially in the early stages, when the amount of coloration is slight, in people of light or fair complexions, whilst in dark people there may be some difficulty in distinguishing it from the normal colour of the skin. The staining in the early stages is nothing more than a slight yellow colour, but as the pigmentation deepens the tint becomes much darker, and in advanced cases it may be bronze or almost green. When the pigmentation is very dark, the term "black jaundice" is sometimes applied to these cases. In the majority of cases it will be found that the jaundice involves the whole surface of the body, and that the depth of the pigmentation does not vary in different parts. It occasionally happens in slight cases, or in the early stages of an attack, that the upper half of the body is alone pigmented. Cases have been described in which the right or left half of the body has been alone affected. I have not seen a case of this kind, and there does not appear to be any record of any such case having been seen during recent years. On this account it is very probable that the older observers who described these cases were wrong in their diagnosis. The mucous membranes become coloured owing to a deposit of pigment. This is not at first apparent, but if pressure be made on the part so as to drive out the blood, the yellow tint will come visible. As has been mentioned, the secretions of the mucous and serous glands, and the secretion of the mammary gland, do not usually contain the pigments of the bile during an attack of jaundice. In rare cases the secretion of the salivary glands has contained a considerable amount of bile pigment. This appears, from the cases which have been recorded, to have occurred nearly always in patients who were taking a preparation of mercury, and often in patients who were salivated. The connection between the administration of mercury and the excretion of pigment in this manner is not clear. The secretions of the glands which open into the alimentary canal (other than the liver) do not appear to contain any bile pigment, as the fæces in cases of jaundice do not contain any bile-colouring matter. The normal fluids which are found as secretions, or rather exudations, in the serous cavities, are, in all cases of jaundice, coloured with the bile pigment, and pathological exudations into these same cavities are coloured in a similar manner.

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[1] Wickham Legg, "Bile, Jaundice, and Bilious Diseases," 1880.

*The urine.*—In addition to the presence of bilirubin, the urine contains in many cases of jaundice the bile acids. In order to detect their presence, it is necessary to separate them from the urine before applying chemical tests which demonstrate their existence. The bile acids are separated from urine by first evaporating it to dryness over a water-bath, and then extracting the residue with absolute alcohol, to which extract is added an excess of ether, when the bile acids are precipitated as crystals. These crystals must be decolorised with charcoal, and then a small amount of the crystalline salt is dissolved in water, and to it Pettenkofer's test is applied. This consists in placing a little of the fluid containing the crystals upon a white porcelain plate, and adding to it a drop of a solution of cane sugar and then some sulphuric acid. If there are any bile salts present, a rich purple colour will appear. It is not sufficient to apply this to urine alone, as there are other substances in urine which give the same reaction, and if they are present in considerable quantity no reliable reaction will be obtained. Bile acids are said to lower the surface tension of any liquid in which they are placed, and if flowers of sulphur are added the powder at once sinks to the bottom, which does not occur in the absence of acids (Hay). If both Pettenkofer's and Hay's tests are applied to a specimen of urine, and both give characteristic results, the urine in all probability can be said to contain bile acids. As, however, the bile acids are present in most cases in such small quantities, Pettenkofer's test will not often be of value. In some cases of jaundice the bile pigments in the urine undergo a process of oxidation, in which case they cause a yellow coloration of the fluid, but they do not give Gmelin's test. Some observers assert that a small quantity of the bile acids is present normally in urine, but this appears to be very doubtful. Golowin in man and animals, and Pye Smith in man, have been unable to detect the presence of bile acids in the later stages of obstructive jaundice, and they think that bile acids are not formed by the liver in the later stages of jaundice. The amount of urea which is excreted with the urine has been found to vary within very wide limits in cases of jaundice. There does not seem to be any direct connection between an attack of jaundice and the amount of urea which is produced within the body. The quantity of chlorides varies in a similar manner to that of the urea. Leucin and tyrosin are only found in the urine in those cases of jaundice which are due to acute yellow atrophy.

*The Fæces.*—When no bile passes into the alimentary canal, the fæces become pale or even white in colour, and generally they are less consistent. In some cases they are said to be more consistent, but in my experience this does not appear to be true; Wickham Legg has had the same experience. Occasionally the fæces are coloured in one part and not in another, an appearance which is probably due to small quantities of bile passing into the intestinal canal, owing to the obstruction not being continuous or complete. In some cases of jaundice the fæces apparently retain their normal colour. This is due in most cases to the administration of drugs or to the passage of blood into the alimentary canal. In other cases it may be due to the passage of a small quantity of bile into the intestine, in those cases where the obstruction is not complete, although it is sufficient to cause the development of jaundice. The fæces in jaundice usually contain an excess of fat, which is due to the non-absorption of the fat which is taken in along with the food. The want of colour of the fæces is said to be due to the absence of stercorin, a substance which is present in normal human fæces and which is apparently a derivative from cholesterin. When the jaundice is due to a catarrhal condition of the bile ducts, it is, as we have seen, often associated with a similar condition of the upper portion of the intestinal canal, and in these cases there is usually diarrhœa, or attacks of diarrhœa alternating with constipation. In chronic jaundice constipation is present in a certain percentage of cases, but in many cases there is persistent diarrhœa or alternating diarrhœa and constipation. In one case, which I had recently under my care, there was persistent diarrhœa, which resisted most measures for its relief. The stools in cases of jaundice usually have a very strong putrid or offensive odour. The digestive processes in many patients are not impaired, but in those in whom the jaundice has been induced by a catarrhal condition spreading from the intestinal mucous membrane, digestive troubles are commonly met with. Patients generally dislike fatty food when they are the subjects of an attack of jaundice. Flatulence and abdominal colicky pains may be present during the course of an attack, but they are not common. The rate of the pulse is often found to be diminished in the course of the affection; it will usually be found to be from forty to sixty per minute, but in rare cases it may be only twenty. This is said by Wickham Legg to be due to the action of the bile acids upon the cardiac ganglia. The temperature in many cases is raised, its course resembling that in an attack of malaria. We shall deal with the temperature in detail later. When the temperature is raised the pulse rate is increased in frequency, but not to so great an extent as under similar conditions without jaundice. The respiration is usually unaffected, but in a few cases hiccup has been met with.

It has been said that a bitter taste in the mouth is a frequent symptom of jaundice, and that this is due to the excretion of the bile acids in the saliva. This symptom appears to be present very rarely, and I have not met with a case in which it was present. Xanthopsia, or yellow-coloured vision, used to be looked upon as a constant symptom in an attack of jaundice. This may have been so in former times, but at the present time it is undoubtedly a very rare phenomenon. Wickham Legg relates three cases in which he found this symptom, whilst Frerichs says that he has never met with such a case. White substances alone are in the majority of cases seen yellow, but all things may appear to have a yellow tinge. The symptom, when present, usually comes on in the later stages of chronic jaundice, and only lasts for a short time, not more than two or three days at the most. The pathology of this symptom is not known.

*Xanthelasma.*—When an attack of jaundice has persisted for a considerable period, it is not uncommon to find, from six to twelve months after the commencement of the attack, that spots of xanthelasma develop. These commence usually on the skin of the eyelids, and later they may affect other parts. The affection is characterised by the formation of small, rounded, or oval patches, resembling pieces of wash-leather implanted in the skin. This condition seems to be due to the growth in the affected part of connective tissue cells, which afterwards undergo fatty degeneration. There are two chief varieties of the disease, the plane and the tuberous. The plane variety involves chiefly the eyelids, but it may be found in other parts,—as, the skin of the face and ears, and sometimes upon the mucous membrane of the mouth. In one case which I saw some time ago, both eyelids were affected, and there were a few patches about the shoulder. The patient was a woman about fifty, who had been jaundiced for a long time. The tuberous variety takes the form of small soft tuberous swellings, which may be grouped together, and are found about the body often around the anus and in the neighbourhood of the genitals. Most cases occur in association with chronic jaundice, but this is not invariable, and occasionally the affection appears to be congenital. Itching of the skin is a not unfrequent symptom of jaundice, and when present it may be very troublesome. It is said to be caused by the presence of bile pigments, which act as irritants, but others maintain that it is the bile acids which are the cause of this symptom.

Drowsiness is an occasional symptom, and a condition of slight lethargy is said to be common. Patients who are the subjects of jaundice do not commonly suffer from sleeplessness, except when itching of the skin is present, or during attacks of pain, such as those due to the passage of a gall stone. In a certain number of cases of chronic jaundice, and occasionally in very acute cases, hæmorrhages are liable to occur. They may be subcutaneous, from the mucous membranes or into the tissues. In the chronic form they come on usually towards the end of the affection, that is, shortly before the fatal termination. Petechiæ in the skin are not uncommon, but probably the commonest seat of the hæmorrhage is from the mucous membrane of the nose, which results in epistaxis. Hæmorrhages into the stomach, or some part of the intestinal canal, are common. Hæmaturia, owing to hæmorrhage from the kidney, is not very common. Almost any part of the body may be the seat of hæmorrhage in jaundice, but those mentioned above are the most frequent. The cause of the hæmorrhage is not very clear. Some have suggested that it is due to the presence of bile acids in the blood; but if this were the case we should expect to have frequent hæmaturia, such as takes place when a quantity of bile acids is injected into the circulation. Possibly it may be induced by a diseased condition of the blood vessels, as the arteries have been found to be atheromatous in some cases.

In all cases of jaundice which go on for some time, there is gradual wasting of the tissues, with accompanying weakness. The cause of the wasting which takes place when the bile ducts are obstructed, has been said by Wickham Legg[1] to be due to the alteration of the glycogenic function of the liver. There are, however, a certain number of cases of jaundice which last for a long time without the patient losing weight or being inconvenienced in any way beyond the pigmentation of the skin.

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[1] Wickham Legg, *op. cit.*

# CHAPTER IV.

## THE DIAGNOSIS OF DISEASES OF THE LIVER AND BILIARY SYSTEM.

THE diagnosis of many of the diseases of the liver and biliary system often requires a very careful examination of the patient, together with a knowledge of the exact history of the different stages of the affection, as they have manifested themselves in the individual case which is under consideration.

*Previous history.*—A history of the previous illnesses and diseases from which a patient has suffered, as well as an account of the time and manner of development of the different signs and symptoms which are met with during the course of an examination, often give important indications in the diagnosis of the nature and complications of a case of biliary or hepatic disease. Thus the previous occurrence of an attack of dysentery or of ulceration of the rectum, or of septic affection of any of the abdominal viscera, will be of value when a supposed case of hepatic abscess is under consideration; whilst the occurrence of attacks of pain which were most intense in the right hypochondriac region, of jaundice, or the passage of gall stones per anum, are facts of great importance in the diagnosis of the existence of biliary calculi. The exact sequence of the symptoms of the present affection should also be carefully inquired into, as not uncommonly important facts are elicited in this way.

*Sex.*—The sex of the patient is of importance when we are dealing with supposed cases of either gall stones or carcinoma of the gall bladder, since in these affections women are found to be much more commonly afflicted than the opposite sex.

*Age.*—Hepatic or biliary diseases are extremely rare in young people of either sex, and it is found that the majority of cases occur in people who are over forty; but certain classes of disease, such as hydatid cysts, abscesses, and jaundice which is due to catarrhal conditions of the mucous membrane of the bile ducts, or to the presence of round worms in these ducts, may occur in people of all ages, whilst those affections which are dependent upon or due to imperfect or abnormal development, are met with at birth, or soon afterwards. Traumatic affections may occur in children, but they are far more commonly met with in adults.

*Climate.*—Hepatic abscesses, that is to say, the tropical variety or those which are due to dysentery, are much more frequently seen in persons who have lived in tropical countries, and they are especially liable to develop in those people who have had an attack of dysentery at some former date. Congestive affections of the liver also are more common in hot climates. Gall stones appear to be met with more frequently in some countries than in others.

*Subjective symptoms.*—Symptoms of a gastro-intestinal disturbance are in many cases either directly associated with, or are the precursors of, an attack of hepatic or biliary disease. Thus it not uncommonly happens that a series of symptoms, due to the existence of a gastro-intestinal catarrh, precedes the development of an attack of jaundice which is due to an inflammatory and catarrhal condition of the mucous membrane of the bile ducts, which has spread by direct continuity from the duodenum to the mucous lining of the common bile duct, and from this to the other bile ducts. In a similar manner, an empyema of the gall bladder may be directly caused by an extension of a septic inflammatory process from the mucous lining of the intestine; and this condition will also in most cases be preceded by the occurrence of symptoms of gastro-intestinal disturbance. The presence of gall stones in the gall bladder, or in one of the bile ducts, may be associated with a series of symptoms which are due to chronic lithæmia. Symptoms of toxæmia may become manifest in cases of acute yellow atrophy, in advanced cirrhosis, and in the later stages of carcinomatous disease of the gland, owing to the fact that the liver cells are unable to perform their normal physiological functions, and destroy or convert into innocuous compounds the various toxines, ptomaines, and leucomaines which have been absorbed from the alimentary canal, or have been produced in the tissues of the body generally, as the result of normal or pathological processes.

Pain is a frequent symptom of hepatic and biliary disease, and it varies in severity and nature according to the character of the pathological condition which is the cause of its appearance. A dull, heavy pain, or feeling of uneasiness and fulness, in the right hypochondriac region, is very common, and when present is often associated with pain which is referred to the inferior angle of the right scapula. This variety of pain is met with in cases of congestion of the liver, in abscesses which have not extended to the surface, and in some patients who suffer from gall stones. The referred pain in the region of the right scapula may extend across the spine to the inferior scapular region of the opposite side. Continuous severe pain in some portion of the hepatic area, which is increased on pressure and accompanied by localised tenderness, is usually met with in cases of perihepatitis. This may be due to the existence of a localised peritonitis, in connection with the surface of the liver, or to the presence of an abscess which has extended to the surface. A shoulder-tip pain may occur in these cases, and when it is met with it indicates that the inflammatory process has extended to the upper surface of the liver and the inferior aspect of the diaphragm, and has irritated the branches of the phrenic nerve. The pain of perihepatitis is usually sudden in its onset, and accentuated by local pressure or by movements. Stabbing, darting, and lancinating pains in the hepatic region are often associated with the existence of cancer of the liver. Acute pain in the right hypochondriac region, usually opposite the cartilages of the seventh, eighth, and ninth ribs, which occurs in paroxysms, and may last for several minutes or even hours, denotes the existence of gall stones, one or more of which has passed into the cystic duct. This calculus may pass backwards into the gall bladder, or onwards into the common bile duct, in which case the pain will cease for a time, but will return when the stone reaches the orifice of the bile duct into the duodenum, or when the same or another calculus passes into the cystic duct. In these cases the pain may be very severe, so as to cause the appearance of a certain amount of collapse and shock, and occasionally it has been known to cause death, in which case a calculus has been found to be partially extruded from the orifice of the common bile duct, where it opens into the second portion of the duodenum. These paroxysms of pain are known as biliary or hepatic colic. When an attack of severe abdominal pain comes on suddenly, commences in the right hypochondriac region, and from there extends to other parts of the abdomen, and is accompanied by the development of shock, collapse, and other signs of acute peritonitis, rupture of the gall bladder, one of the bile ducts, a hepatic abscess, or hydatid cyst, may be suspected, especially when there have been symptoms which connect the affection with the region of the liver. When patients are being examined, who are the subjects of pain in the region of the liver, it must be remembered that pleurisy and basal pneumonia may give rise to the appearance of symptoms which simulate hepatic affections.

*Objective symptoms.*—In dealing with all cases of diseases of the liver or the biliary system, a careful physical examination should be made in every case.

(1) *Inspection or adspection.*—The superficial veins in the subcutaneous tissues which overlie the hepatic region and adjacent parts of the abdominal wall may be seen to be enlarged and dilated, in which case the existence of an obstruction to the free flow of blood through the portal vein or the inferior vena cava will be indicated. This symptom is often met with in patients suffering from advanced alcoholic cirrhosis of the liver. Jaundice is a frequent symptom in both hepatic and biliary disease; but, owing to its great importance, it is considered in a separate chapter. A localised swelling or prominence may be evident in some portion of the hepatic area, and cause a projection of the upper part of the abdominal wall, or the lower portion of the thorax. This condition has been met with in hydatid disease of the liver, in cases of hepatic abscess, in cancer of the liver, and also in enlargements of the liver which are due to fatty, amyloid, or syphilitic disease. When the gall bladder is very much enlarged or distended, it may give rise to the appearance of a prominence which extends downwards for a variable distance below the costal margin, reaching beyond the umbilicus, and even as low as Poupart's ligament. Several nodular prominences may be apparent externally in rare cases, and when met with they usually indicate the presence of multiple cancerous growths, or occasionally multiple cysts. Xanthelasma, both the tuberous and flattened varieties, may be met with as a concomitant of hepatic disease, especially in those cases in which jaundice has existed for a long time.

(2) *Palpation.*—When the surgeon examines the hepatic region, the patient should be instructed to lie in the dorsal position, with the thighs partially flexed, so as to relax the

abdominal muscles; the shoulders should be elevated, and the breathing should be deep and quiet. The palmar surfaces of the surgeon's fingers are then laid upon the skin of the right hypochondriac region, a short distance below the costal margin, with the finger-tips somewhat flexed, so that they look upwards and towards the middle line of the body. Firm but gentle pressure is then made during an inspiration, and if the liver is enlarged it can be distinguished as it passes downwards underneath the fingers. In children, in those who have thin and lax abdominal walls, or in women who have pendulous abdomens as the result of frequent child-bearing, the lower margin of the liver can be felt in a state of health. In some cases in which it is wished to palpate the liver, it may be necessary and advisable to place the patient in a sitting posture, with the trunk bent slightly forwards, so as to relax the abdominal walls as much as possible. In this case the surgeon stands a slight distance behind the right side of the patient, and applies his hand and fingers as directed above, the finger-tips being pressed well inwards. The liver may then be felt to descend during deep inspiration, and the shape and form of its lower and anterior portions can be made out. When the abdomen is distended with ascitic fluid, or by intestines dilated with gas, the tips of the fingers should be suddenly pressed downwards into the hepatic region, and the liver, if it is enlarged, may then be felt as a solid resisting body, after the fluid or the distended intestines have been pushed to one side. Palpation over the surface of a swelling which lies in close relation to the posterior aspect of the abdominal wall, may detect the presence of fluctuation, in which case the existence of an abscess or a fluid-containing cyst, such as a hydatid, will be suggested. When the liver is the seat of much enlargement, the characters of this enlargement can usually be made out by a careful palpation. When the gall bladder is distended with bile or pus, or is enlarged owing to the presence of large calculi or of a malignant growth, it can be felt to protrude below the costal margin, opposite the ninth costal cartilage of the right side. It is said that a distended gall bladder tends to extend downwards in the abdominal cavity, in a line directed towards the centre of Poupart's ligament on the left side. This, however, is not the invariable direction which an enlarged gall bladder takes, since its course may be altered by the formation of adhesions, and by the weight of its contents. The enlargement of the liver may be general or localised, and in the latter case there may be several eminences or irregularities upon its surface. In all cases of hepatic tumours and enlargements, movements which are synchronous with those of respiration can be made out. The movements of a displaced or of an enlarged liver can generally be distinguished by careful palpation, especially in those patients who have lax abdominal walls. It is found to be necessary to anæsthetise the patient in some cases, in order to render the abdominal walls flaccid, and enable the surgeon to detect those signs which can be distinguished by palpation. In some cases of perihepatitis it is possible to distinguish fremitus with the palpating finger.

(3) *Percussion.*—The height to which the liver extends upwards on the right side can be mapped out by percussion, but on the left side of the body the liver dulness is continuous with that which is due to the presence of the heart, whilst the lower border of the organ in the abdomen can be readily made out. Growths from, and enlargements of, the right kidney may simulate hepatic enlargements; but usually percussion in the latter class of cases will succeed in defining an area of resonance between the upper margin of a renal swelling and the lower border of the liver, owing to the presence of the colon in the groove between the two viscera. In order to obtain this resonance, or to prove its absence in those cases in which considerable doubt exists, it may be requisite to distend the colon with gas from the anus by the introduction of a tube into which gas is pumped.

(4) *Auscultation.*—In the majority of cases of hepatic tumours, auscultation is of very little service in assisting the surgeon to make a diagnosis. Occasionally, however, friction can be heard in the hepatic area, due either to a localised perihepatitis, or to the bruits of a hepatic or an aortic aneurism. This method of examination is of great value in those cases of basal pneumonia of the lung which simulate affections of the liver.

(5) *Exploratory puncture with the needle of an aspirator.*—In many cases of a fluid swelling in connection with the liver or the gall bladder, it is necessary to obtain some of the fluid contents before it is possible to make an exact diagnosis of the nature of the disease from which the patient is suffering. It is

not advisable, however, to adopt this method of examination in a routine fashion, as it has been followed by fatal results in several recorded cases. In those cases in which an abscess has been proved to be present by aspiration with the needle of an exploring syringe or an aspirator, the surgeon should always be prepared to perform an operation for the evacuation of the pus, since it is liable to leak into the peritoneum along the track of the needle, and set up a general septic peritonitis.

# CHAPTER V.

## MALFORMATIONS.

Malformations of the liver and the biliary system are not common, and they have only occasionally been observed. The biliary ducts or the gall bladder are more frequently involved than the liver itself. These affections may conveniently be divided into two groups, according to their mode of origin, namely, (*a*) those of congenital origin, and (*b*) those of acquired origin. The liver is more often the seat of acquired than congenital malformations, whilst in the biliary system congenital malformations are more frequent than the acquired. These different classes of deformities will be considered separately.

Congenital Malformations of the Liver.—The congenital malformations of the liver are exceedingly rare, and do not call for a detailed description, since, in the majority of cases, they do not give rise to a definite train of symptoms by which their presence can be recognised. The condition of hepatomphalos is, however, of surgical importance, and will be described in more detail. The existence of all the varieties of malformation ought to be known to the surgeon; as, in dealing with obscure cases of hepatic disease, a knowledge of these malformations may materially assist in the establishment of a correct diagnosis, or, at least, may aid in preventing errors. The most important congenital malformations of the liver are the following, namely—

(1) *Complete transposition of the whole viscus*, in which case the large lobe of the gland is situated in the left hypochondriac region and the smaller lobe in the right hypochondrium. When this condition of affairs obtains, it will, as a general rule, be found that there is a transposition of the whole of the viscera, the heart lying in the right side of the thoracic cavity, and the spleen in the right hypochondrium. I have not met with any cases, nor seen the records of any, in which this malformation of the liver was not associated with a transposition of the viscera.

This form of malformation of the liver is the most important from the point of view of diagnosis.

(2) *The presence of accessory lobes.* — This variation is occasionally met with during post-mortem examinations. The lobes are usually very small, and situated upon or in connection with the inferior surface of the gland. In the post-mortem room of St. Bartholomew's Hospital I have several times seen these accessory lobes, but in every case they have been small, and not larger than a pea or small hazel-nut. In the museum of the Hospital there is a drawing of a liver with a small pedunculated lobe attached to the inferior surface of the right lobe. I have occasionally observed the presence of additional fissures upon the surface of the liver, especially in some part of the right lobe, which have caused an appearance of accessory lobes, but in no case have these fissures completely separated a portion of the gland. Dickinson[1] has described the liver of a patient which was the seat of extensive lobulation, and in appearance resembled the liver of a rabbit. Other observers have occasionally met with similar appearances. The abnormal lobes cannot usually be distinguished clinically during life, and it is only when the post-mortem examination is made that the differences in form become apparent.

(3) *Left lobe, long and thin.*—The left lobe has been met with as a long, thin, tongue-like process, which extended downwards and towards the left into the left hypochondrium, or even into the left lumbar region as far as the spleen, or even below this viscus. When this form of lobulation is present it may be mistaken for an enlarged spleen, but usually its easily definable connection with the liver, and its very free movements during respiration, will indicate the nature of the enlargement or swelling in the left hypochondrium.

(4) *Absence of left lobe.*—In a few cases the left lobe is found to be entirely absent, or merely represented by a small mass of fibrous tissue. This variation gives rise to no symptoms which suggest the presence of the deformity.

(5) *Liver rounded in form.*—Occasionally the whole liver may be rounded in form and have no easily definable lobes, or it may have the form of a quadrilateral or quadrangular body. In the former of these varieties the inferior border may not be so easily palpable as when it has the ordinary conformation; but as

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[1] Dickinson, *Trans. Path. Soc. London*, vol. xvii., p. 160.

in many instances the lower edge cannot be felt in normal cases, this fact is of no importance; the quadrangular form cannot be distinguished by palpation.

(6) *Deep fissures.*—The normal fissures of the gland are deeper than usual in some cases, or there may be one or more additional grooves, especially upon the inferior surface of the right lobe. None of these conditions occasion any symptoms, and they are of very little clinical interest. They are, however, of a certain amount of pathological interest, since they explain the presence of grooves and additional fissures which are found in some cases post-mortem, and in which there are no other signs of disease of the liver. This is especially the case in connection with the livers of children. The exact cause of the formation of additional lobes and fissures has not been explained from a developmental point of view. Possibly some of the cases may have been caused by an intra-uterine perihepatitis. This, however, will not explain the presence of the small pedunculated lobes which have already been described.

(7) *Congenital apertures in diaphragm.*—It happens in rare cases that some portion of the diaphragm is congenitally absent, so that there are one or more apertures through which a portion of the upper surface of the liver may extend into the thoracic cavity, either into the pericardium or into one of the pleural cavities, forming a diaphragmatic hernia. This condition is very rare, and it does not appear to be possible to diagnose its existence during life. When, however, there is an area of the chest wall, which is persistently dull to percussion, and which is not associated with a train of symptoms attributable to a pathological condition of one of the thoracic viscera, the possible presence of a diaphragmatic hernia must be borne in mind.

(8) *Hepatomphalos.*—When the abdominal wall fails to be completely closed in at the umbilicus and in the median line immediately above it, a portion of the liver may protrude, or if a hernia arises in this situation as a result of imperfect development, the liver may form the whole or a part of the contents of such a hernia. This condition is known as hepatomphalos. Albert Wittig has recorded a case of this kind.[1] The patient was a child born at the full term of pregnancy, with a tumour of the umbilical region. This tumour had the characteristics of a so-called funicular hernia, and its contents consisted of a con-

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[1] Albert Wittig, "Hepatomphalos," Inaug. Diss., Königsberg, 1888.

siderable portion of the liver. When this condition is present it is characterised by the following symptoms. At birth a tumour projects from the region of the umbilicus, or through the middle line of the abdominal wall between the umbilicus and the lower extremity of the ensiform cartilage, the contents of which are in part or entirely solid, smooth to palpation, dull to percussion, and continuous with the lower part of the liver above. The tumour moves upwards and downwards synchronously with the movements of respiration.

*Diagnosis.*—The diagnosis of hepatomphalos will easily and readily be made by paying attention to the existence of a series of physical signs similar to those described above, and by ascertaining by palpation the presence of a tumour which is in direct connection with the liver.

*Treatment.*—If it is found to be impossible to reduce the herniated portion of the liver into the abdominal cavity, it may be requisite to remove the protuberant portion by a surgical operation. The method of performing such an operation is described in the chapter upon operations.

ACQUIRED MALFORMATIONS OF THE LIVER.—The acquired malformations of the liver, which are not due to disease, are in nearly all cases caused by the practice of wearing tightly-laced corsets. In the majority of instances the affection is found in persons of the female sex, but the practice of wearing tightly-fitting belts has been known to produce a similar affection in men. In all cases, as a result of the pressure which is exerted upon the liver from without, the gland tends to become compressed, and to be partially subdivided into two superimposed halves. In the slighter cases, and in the early stages of the well-marked ones, a circular depression is formed upon the external surface of the liver, a short distance above its inferior border. The earliest result of tight-lacing appears to be the pressing inwards of the lower part of the costal arch and forcing downwards of the liver. Next, the liver itself becomes compressed, and acquires upon its external surface a horizontal depression, which is most marked upon the right lobe. In the more marked cases the liver projects downwards a variable distance below the costal margin, often extending as far as the umbilicus, or even lower. In the Museum of St. Bartholomew's Hospital there is a specimen of the liver and gall bladder of a female[1] who was admitted into the Hospital for symptoms of strangulated hernia. When the operation for the relief of this condition was performed, the hernial sac was found to be occupied by the fundus of the gall bladder, and the liver was felt to extend as far downwards as Poupart's ligament. This condition has been caused by wearing very tightly-laced corsets, the liver being very much constricted. In addition to the lower portion of the liver being pressed downwards into the abdomen, the upper part of the gland may be pressed upwards in a similar manner, so as to encroach upon the thoracic space, owing to the elevation of the diaphragm. These abnormal conditions do not in the majority of instances give rise to the appearance of many symptoms. The symptoms which are present are due more to the obstruction to the free movements of respiration, and to pressure upon the heart and pericardium. This form of malformation of the liver is said to predispose to the development of gall stones in the gall bladder, and also to explain to a certain extent the greater frequency of these concretions in the female sex. By some authors the practice of tight-lacing is said to predispose the patient to attacks of "biliousness." As regards the treatment of this class of case, the best method is that of removing the exciting cause. All tightly-fitting garments must be prohibited, especially any which tend unduly to constrict the waist. If these injunctions are carried out, the liver will, to a certain extent, recede upwards beneath the ribs, and resume somewhat its original form. If, however, the practice of wearing tightly-fitting corsets has been made use of for a long time, so that the costal arches have become much deformed, it is not probable that they will return to their pristine shape, but usually improvement will take place. It is quite common in the post-mortem room to find evidence of a constricted liver, which during life had not given rise to any definite train of symptoms.

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[1] *St. Barth. Hosp. Museum*, Spec. 2114.

CONGENITAL MALFORMATIONS OF THE BILIARY SYSTEM.—The congenital malformations of the biliary system, especially when affecting the gall bladder or the common bile duct, are of considerable surgical importance, since it appears to be possible that, in the future, some of them will be amenable to direct surgical interference. The varieties and forms of these malformations which have been described are the following, namely—

(*a*) *Total absence of the gall bladder and the cystic duct.*—When this deformity is present, the common bile duct is usually found to be enlarged a short distance above the entrance into the duodenum, so as to form a fusiform sac, which may serve to a certain extent as a substitute for the gall bladder in the storage of the bile which is secreted between the periods of digestion. No definite set of symptoms are attributable to this condition alone, and its existence only becomes apparent at a post-mortem examination, or when the abdominal cavity has been opened for some other affection.

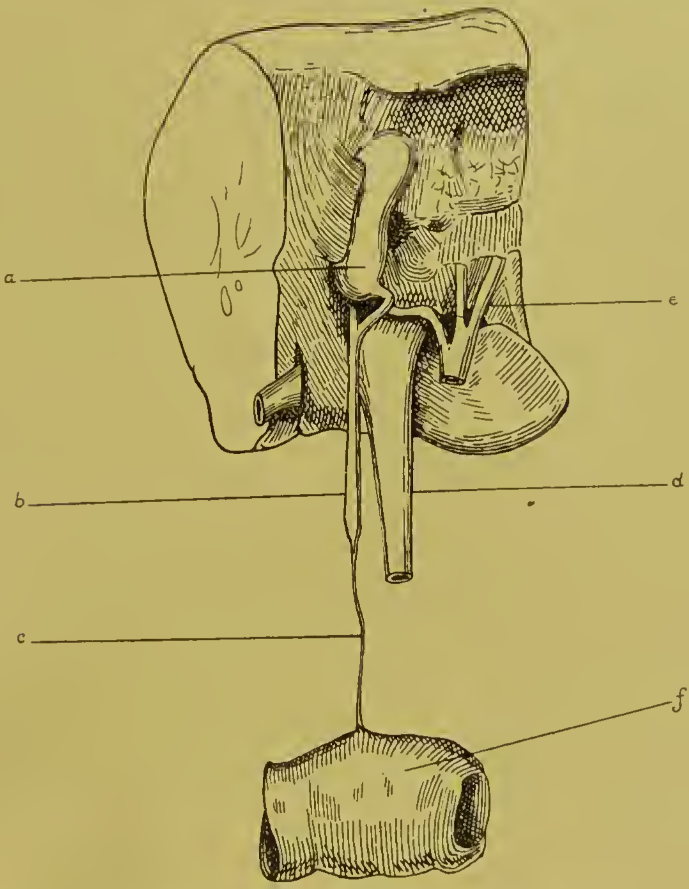

FIG. 10.—Congenital obliteration of the ductus communis choledochus. *a*, gall bladder; *b*, unobliterated portion of common bile duct; *c*, obliterated portion; *d*, portal vein; *e*, hepatic artery; *f*, duodenum.—*Museum, Royal College of Surgeons.* (For description see *Trans. Path. Soc. London*, 1895, p. 76.)

(*b*) *Obliteration, stenosis, obstruction, or absence of the common bile duct.*—This is perhaps the commonest form of congenital malformation which is met with in the biliary system, and it is one which possibly may be relieved by a surgical operation, if it is not associated with a similar condition of the hepatic or cystic ducts. It is characterised by the existence of a constriction in the course of the common bile duct, generally a short distance beyond its commencement, that is, beyond the union of the common hepatic duct and the cystic duct. The duct at the constricted portion has in most cases the appearance of a fibrous cord, extending towards the duodenum, and in which there is no trace of a lumen. In some cases all trace of a fibrous cord has disappeared, and the patent part of the bile passage has no connection with the duodenum, and in others the constriction may be incomplete, so that a small lumen is left in the centre of the fibrous cord, through which bile may pass into the duodenum. The length of the obliterated or constricted portion is not generally more than a half or three-quarters of an inch.

*Pathology.*—The exact cause of this condition does not appear to be very clear, although several theories have been advanced which may explain it. We have already seen that the liver is developed from a solid outgrowth of the epithelium which lines the primitive alimentary canal, and that this outgrowth becomes hollowed out at a later period. It seems possible, and in a few cases even probable, that these malformations may be due to arrested, defective, or abnormal development. It has been thought by some observers that the hollowing out of the solid outgrowth has failed to take place at that part of the bile duct which is impermeable. In the majority of these cases, however, the meconium is found to be coloured at birth, a fact which is in favour of the previous existence of a communication of the bile duct with the duodenum which allowed the bile to pass along. It is more probable, as has been suggested by John Thomson,[1] that the hollowing out of the solid outgrowth only takes place to a limited extent, and that a congenital narrowness or irregularity of the lumen of the duct is first produced, which is of such a nature as to render it especially liable to the development of pathological conditions, which bring about its obliteration. Arrested development appears to be the explanation of the absence of the gall bladder in a certain number of the cases. In others, however, where the gall bladder is represented by a quantity of fibrous tissue, it is more probable that its obliteration has been brought about by some inflammatory process. The congenital narrowness which is due to defective developmental processes, may involve a considerable length of the bile ducts, and cause the varieties of malformation which are enumerated next. Localised peritonitis occurring in the early stages of intra-uterine life has by some authors been thought to be the cause of these affections. This, however, is supported by very few definite observations. If this were the pathology of the disease, we should expect to find adhesions of the bile ducts to the surrounding structures, and that the external portions of the obliterated ducts were most involved in the pathological process. Adhesions are present in some of the cases, but in these the constricting process does not appear to have extended from without, but from within. Syphilis has also been said to be the cause in some of the recorded cases. There is not much evidence in favour of this suggestion, and of the cases which have been described, in only a small percentage has syphilis been stated to have been present either in the child itself or in the parents. The cirrhosis of the liver which is found in most of the cases has been attributed without sufficient reason to syphilis, but in most it will be found that this condition is really one of biliary cirrhosis, which has been induced by the biliary obstruction. Intra-uterine affections of the walls of the biliary ducts have been thought to be the important etiological factors in the establishment of the malformations. Thus, gall stones have, in one case which has been recorded by Lieutaud, been met with. Inflammation of the mucous membrane of the duct is a possible cause, but there is no evidence in favour of this. It seems more probable, when inflammation is present, that it has been induced by the previous formation of stenosis of the duct, and that the inflammation has expedited the complete obliteration of the lumen. Beck has described a case in which the blocking was apparently due to the formation of localised gummata. It has been found that in some of the recorded cases more than one member of the same family has been similarly affected. Binz[1] and Gould[2] have both described cases in which two children of the same parents have been affected. Many cases have also been placed on record where other children have either suffered from jaundice soon after birth, or have died from diseases in which jaundice was a marked symptom. These facts seem to be more in favour of the malformations being the result of defective development. The total obliteration of the lumen of the ducts occurs at a variable period. In most cases it is complete in the early stages of intra-uterine life, but occasionally it does not take place till later, and there are a few cases in which it apparently did not take place till a short time after birth. When the ducts have become blocked, accumulation of bile behind the seat of the obstruction occurs, and this soon sets up biliary cirrhosis, which increases and causes interference with the functions of the liver. Cholæmia is induced, and, along with it, its characteristic symptoms. In a few cases the inflammatory process which follows the establishment of obstruction spreads to the adjacent portion of the peritoneum, and sets up a localised peritonitis.

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[1] Thomson, *Edin. Med. Journ.*, vol. xxxvi. p. 523 *et seq.*

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[1] Binz, *Virchow's Archiv*, Bd. xxxv. s. 296.

[2] Gould, *Boston Med. and S. Journ.*, 1855, p. 109.

*Symptoms.*—At birth the child is in most cases found to be jaundiced, but in a few the skin is quite free from yellow discoloration, and the jaundice comes on shortly afterwards. The discoloration of the skin gradually increases in intensity; the urine is dark, owing to the presence in it of bile pigments, and the child suffers from constipation. The first stools which are passed, and which consist of meconium, vary as regards their colour. In some cases the meconium is coloured green, owing to the presence of pigments derived from the bile, whilst in others it is white or almost colourless. In the former cases the obliteration of the duct only took place after a certain amount of bile had been secreted by the liver, and had been poured into the duodenum; in the latter, the obliteration probably became complete at an early period of intra-uterine development. In some cases the jaundice, after it has been established, may decrease in intensity and the child undergo an apparent improvement. This, however, is only of temporary duration, and soon the jaundice again deepens and further symptoms develop. Nutritional disturbances manifest themselves at a variable date after the appearance of jaundice; in some they are apparent after a few weeks, whilst in others they do not become well-marked until after the expiration of one or two months. In the advanced stages attacks of vomiting and convulsions are frequent, and are probably due to the occurrence of a species of blood-poisoning. Enlargement of the spleen has also been noted as a common symptom in the later stages. Spontaneous hæmorrhages occur in nearly all cases which last for a few months. Hæmorrhage from the umbilicus is the most frequent, but epistaxis, hæmorrhage into the tissues and into the alimentary canal, are not uncommonly met with. The hæmorrhage is in all probability induced by the condition of the tissues, owing to their impregnation with the non-eliminated biliary excretion. When hæmorrhages occur they are very persistent, and cannot be arrested by ordinary measures. Usually they continue until death, and in many cases they are its immediate cause. The duration of life in children suffering from congenital obliteration of the common bile duct varies between a few weeks and several months. John Thomson [1] collected forty-nine cases of congenital obliteration of the bile ducts, and found that out of these, eleven lived less than a week, eight more than a week and less than a month, fourteen from one to four months, and sixteen more than four months, two of these having lived until the eighth month. In one case of obliteration of the common bile duct, which has been recently reported by Francis Hawkins,[2] the child lived for four and a half months (Fig. 10). In a few of the recorded cases a green coloration of the fæces has been noted during the later stages of the affection. This appears to have been due to mercury having been administered; which substance has formed green-coloured compounds with some of the contents of the bowel.

*Diagnosis.*—Absence of coloured matter in the intestinal excreta of a child at birth, or coming on soon afterwards, which is co-existent with, or immediately followed by, the appearance of jaundice, which is persistent and increases in intensity, points to the existence of some obstruction to the flow of bile from the biliary passages into the duodenum. It is not uncommon, however, for a young child to suffer from jaundice, owing to the blocking of the common bile duct by a catarrhal condition of the mucous membrane, or by a plug of mucus which has become inspissated and impacted at the entrance of the duct into the duodenum. In both of these classes of cases the meconium is dark-coloured, owing to the presence of biliary pigments, and the condition clears up spontaneously in a few days, or yields to medical treatment. Icterus neonatorum, which comes on shortly after birth, lasts for a short time, and is due to change of the blood pigments in the skin, must not be mistaken for the jaundice of obliteration. This variety only lasts for a short time, and soon clears up spontaneously. All cases of jaundice occurring in the newly-born, require to be watched for some days before it can be definitely stated whether the jaundice is due to permanent blocking of one or other of the bile ducts, or is due to other less persistent causes.

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[1] John Thomson, *Edin. Med. Journ.*, vol. xxxvi. p. 523 *et seq.*

[2] Hawkins, *Trans. Path. Soc. London*, 1895, p. 76.

*Treatment.*—When the existence of a permanent congenital obstruction of the entrance of the bile into the duodenum has been diagnosed with a fair amount of certainty, there appears to be only one method of treatment which offers a possibility of relief to the condition being afforded. An exploratory laparotomy should be performed, the incision being made in the middle line above the umbilicus, or in the right linea semilunaris, commencing at the lower margin of the costal arch. In most cases it will be better to make the median incision, but if a localised swelling can be distinguished, which extends more to the right, then it will be advisable to make the incision in the right linea semilunaris. The structures in the portal fissure of the liver and its neighbourhood should be carefully examined, together with the gastro-hepatic omentum and the duodenum. If it is found that the common bile duct is obliterated above its entrance into the duodenum, that the gall bladder is present and of normal size, and its cystic duct is patent and communicates with the hepatic ducts, which also are patent, then a fistulous communication should be made between the gall bladder and the duodenum. This can be done best by the use of a small "anastomosis button," assisted by a few stitches. The details of this operative procedure are described later. If the gall bladder is absent and the common bile duct obliterated, then the only thing which can be attempted will be to establish a communication between the lower extremity of the dilated portion of the bile duct and the duodenum. In the majority of cases this will in all probability be found to be almost impossible.

*Prognosis.*—If the patients with congenital obliteration of the common bile duct are left untreated, they all die; but as yet no cases have been recorded which have been treated in the manner which is advocated above. It seems, however, to be quite possible, and even probable, judging from the result of cholecystenterostomy in older people, that there is a chance of the procedure proving successful in suitable cases. It must be remembered that there is only a limited number of these congenital cases which will be found to be suitable. In most cases, in addition to obliteration of the common bile duct, there are other more extensive lesions which do not lend themselves to successful operative interference. In John Thomson's [1] paper, already referred to, diagrams are given of twenty-nine of the recorded cases, and out of these only six appear to have been suitable for the application of this method of treatment. Giese has recently collected twenty-seven cases, and out of this number he found that only three were suitable for the performance of an operation which would have a fair chance of being successful. The suitable cases are those described by Köstlin,[2] Roth,[3] and Legg.[4] To this list may be added the case of Francis Hawkins [5] (Fig. 10). As, however, the affection if left alone is necessarily fatal, it appears to be quite justifiable to attempt to relieve it by surgical measures.

*Congenital obliteration of the common hepatic duct.*—This is a very rare condition, and when it is met with it gives rise to a train of symptoms which are indistinguishable from those which occur when the common bile duct is obliterated. In some cases it is associated with obliteration of the common bile duct or the gall bladder, and its existence can only be definitely diagnosed after an exploratory examination of the biliary passage has been carried out. The common hepatic duct and the right and left hepatic ducts are usually represented by solid white cords of fibrous tissue, which extend into each extremity of the portal fissure. In some cases the common hepatic duct has alone been found to be obliterated, and in others the right and left hepatic ducts are closed as well, whilst occasionally the right or left hepatic duct, or both, have been obliterated. The left duct may be obliterated alone, and give rise to no symptoms, but this is very unusual. When the hepatic ducts are obliterated, it does not seem to be possible to perform any surgical operation which will be of avail in rectifying the condition. All these cases must apparently terminate fatally. If the gall bladder and the cystic and common bile ducts were normal, and there were also present hepato-cystic ducts, which have occasionally been met with, it seems to be possible that the bile might pass into the intestine by this route from the liver, but no case of this nature has been recorded.

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[1] Thomson, *loc. cit.*

[2] Köstlin, *Med. Cor.-Bl. d. württemb. ärztl. Ver.*, Stuttgart, 1862, Bd. xxxii.

[3] Roth, *Virchow's Archiv*, Bd. xliii. s. 296.

[4] Legg, *loc. cit.*

[5] Hawkins, *loc. cit.*

# CHAPTER VI.

## ABSCESS OF THE LIVER.

An abscess of the liver may arise as the direct or indirect result of a considerable number of different pathological conditions. In each case a localised hepatic inflammation is induced, which terminates in the formation of a collection of pus. This condition is usually associated with the entrance of a quantity of septic material into some portion of the liver. The resultant abscesses may be either multiple or single, those of pyæmic origin being almost invariably multiple. A special variety of the affection is known as tropical abscess, and occurs in individuals who reside or have resided in hot climates.

Etiology.—The etiology of inflammation of the liver and hepatic abscesses may be considered under many distinct headings, but for convenience of description, these will be separated into the following seven groups, viz.:—

1. *Traumatism.*—Some portion of the liver may receive an injury from without, such as a blow, or a fall against an obstacle, and as a result of this the liver tissue at the point of reception of the force undergoes a solution of continuity, and a rupture occurs, either superficially or into the substance of the gland. The damaged part may undergo resolution and no serious complication follow, or micro-organisms may be carried to it by the blood stream, which grow and multiply so as ultimately to lead to the development of an abscess. The formation of abscess may be delayed until some time after the injury. Severe and extensive ruptures of the liver are quickly fatal in the majority of instances, and it is only the slighter varieties which may become the seat of the development of an abscess. Haspel[1] has described the case of a soldier who received a severe blow in the right hypochondriac region, and died from a hepatic abscess eleven days afterwards. Cases have also been described in

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[1] Haspel, "Henoch's Unterleibskrankheiten," 1864.

which children have died from hepatic abscesses caused by falls from a height. Fish bones, pins, and needles which have been swallowed, have been found in the interior of a hepatic abscess, having perforated the walls of the stomach and then passed into the liver. Abscesses of the liver, as the result of non-perforating injuries, are exceedingly rare, and, according to C. Langenbuch,[1] only thirty-nine cases are recorded in surgical literature. Perforating wounds of the liver are more commonly followed by the formation of an abscess than the non-perforating ones. These wounds may be due to stabs with sharp instruments, or blunt bodies may be driven through the abdominal or thoracic walls into the liver substance, or the perforating body may be the projectile of a firearm. In all these cases, if the injury is not very extensive, the development of an abscess may follow. Septic matter may be introduced either at the time of injury or later, by means of the blood stream or by unclean instruments which are used to examine the wound. Portions of the perforating body may be detached and left in the bottom of the wound, or a piece of the clothing may be carried in. All cases of abscess of the liver which are caused by perforating wounds are associated with the presence of the micro-organisms of suppuration. A foreign body which has been introduced into the liver in the manner described above is not always immediately followed by the formation of an abscess, since the foreign body may become encapsuled in the liver substance and surrounded by a layer of dense fibrous tissue, when it remains quiescent for a long time. When an encapsuled body is located within the liver, it is liable at any time to become the seat of an inflammatory process which may terminate in the formation of an abscess. An hepatic abscess may thus occur after the lapse of a considerable length of time from the introduction of the foreign body.

2. *Gall stones.*—Gall stones are not unfrequently the cause of hepatic abscess in non-tropical climates, and they can produce this result in several ways. When the gall stones are located within the gall bladder, they are liable, by a process of constant irritation, to cause inflammation and ulceration of the mucous membrane which lines the internal aspect of the sac, and if this inflammatory condition extends to the neighbouring portion of the liver, it becomes the direct cause of the formation of an abscess. In other cases the gall stones may be impacted in the

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[1] Langenbuch, "Deutsche Chirurgie," Lief. 45 c, Theil. i. s. 205.

cystic duct, or in some part of the intra-hepatic bile ducts, and by a similar process of irritation, inflammation, and ulceration, induce the development of an abscess. The gall stones which are found in the intra-hepatic ducts may have arisen within the liver, or they may have migrated there from the gall bladder along the cystic and hepatic ducts. The micro-organisms of suppuration play a very important part in the development of abscess dependent upon gall stones. The *Bacterium coli commune* has not uncommonly been found in the pus of abscesses which have arisen in this manner. This micro-organism is always to be found as an inhabitant of the human alimentary canal, and when it is found in connection with inflammatory processes due to the presence of gall stones, it has, in all probability, in most cases reached the liver by passing along the bile passages from the duodenum. Gall stones which have become impacted in some portion of the common bile duct have been found to be the cause of the formation of an hepatic abscess in a small proportion of cases. It has been suggested with a very fair amount of reason, that in these cases the gall stone, when impacted, causes ulceration of the mucous membrane, and the ulcerated surface becomes the seat of growth of suppurative micro-organisms, which have migrated from the adjacent portion of the intestine; colonies of these micro-organisms then enter the small veins or capillaries which return the blood from the walls of the common bile duct, and pass along with the blood stream into the portal vein and thence into the liver, where they are arrested in the intra-hepatic capillaries of the portal system, and give rise to the development of abscesses in the manner described in connection with portal pyæmia. Gall stones have been found in the interior of abscesses which have arisen according to the two first of the above ways, either post-mortem, or when the abscess has opened externally and discharged its contents, or when it has ben incised and evacuated by the surgeon. Cases have been described in which the abscess has opened into some part of the alimentary canal and the pus and gall stones have been passed per anum, or vomited up when the stomach has been the seat of the perforation.

3. *Parasites* (*animal*).—Several varieties of animal parasites have been met with, as the direct cause of the development of an abscess of the liver.

(*a*) *Ascarides*, or round worms, may inhabit the upper part of the intestine in man, and cases have been recorded in which they have passed through the aperture of the common bile duct into the duodenum, and thence along the biliary passages to the gall bladder, or to the intra-hepatic portions of the bile ducts. When they have gained an entrance into the bile ducts or gall bladder, they usually become coiled up and soon die, owing to the poisonous effect of the bile upon them. They act as irritants to the mucous membrane lining the interior of the bile passages, and induce the formation of an abscess in a manner similar to gall stones, but as they have passed directly from the small intestine, suppuration commences at an early period, owing to the presence of the micro-organisms which they have carried with them. The formation of an abscess is not the invariable result of the passage of a round worm into the biliary ducts. When the parasite has been killed by the action of the bile, it may be extruded into the duodenum by the contraction of the muscular walls of the ducts. Cases have been met with and described where a dead ascaris has been passed externally, either when a hepatic abscess has opened spontaneously on the surface of the body, or has been evacuated by the surgeon. The formation of a hepatic abscess as the result of the presence of an ascaris within the liver is a very rare condition, and when present it can scarcely be distinguished clinically from an abscess which is due to a gall stone. This condition, however, is liable to occur in children and young adults, and if the patient is known to be suffering from ascarides, and the formation of a hepatic abscess has been preceded by attacks of violent biliary colic, this cause must be taken into consideration when making a diagnosis. It usually happens that a single ascaris finds its way into the liver, and a single abscess is the result. Cases, however, have been recorded in which multiple abscesses have formed after several of the parasites have passed into the bile ducts. Bargioni[1] has described a case in which sixteen round worms were found in the liver of a patient after death. In the Dupuytren Museum in Paris there is a human liver into which eleven adult round worms have passed along the course of the bile canal. According to Davaine[2] an ascaris does not live more than twenty hours after it has obtained an entrance into the bile ducts. Nearly all the recorded cases have occurred in children or young adults.

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[1] Bargioni, quoted by Langenbuch, *op. cit.*, s. 207.

[2] Davaine, "Traité des entozoaires," 1877.

(*b*) *A hydatid cyst* of the liver may become the seat of a suppurative process which terminates in the establishment of a hepatic abscess. The inflammation and suppuration may commence in the liver tissue which immediately surrounds the cyst, so that the parasite lies in a bed of pus, but sooner or later the cyst itself is involved, and its interior becomes filled with the products of suppuration; in other cases the cyst and its contents are first affected in the inflammatory process, and the neighbouring portion of the liver is involved afterwards. The exciting causes of suppuration of a hydatid cyst are not always apparent. An exploratory puncture with the needle of an aspirator has been the direct cause of the introduction of septic micro-organisms, and a blow or contusion in the hepatic region has preceded the occurrence of this complication. Often, however, it is not possible to refer it to any definite cause. The symptoms are those of an ordinary hepatic abscess, preceded by those of hydatid disease, if the hydatid cyst has attained any considerable size or has commenced to exhibit pressure symptoms. A small hydatid cyst may become the seat of an inflammatory process which terminates in abscess without having previously exhibited any symptoms by which its existence can be surmised.

(*c*) *Distomata.*—In tropical and subtropical countries the *Distoma hæmatobium* has been found in the liver, occupying the portal canals, and, in rare cases, causing an abscess of the liver. This appears to be an occasional cause of hepatic abscess in Egypt. Arnold[1] has recorded a case of abscess of the liver, which he opened by operation, and in the pus which was evacuated he found an adult distoma. In the Museum of St. Bartholomew's Hospital[2] there is a preparation of a human liver, in which are seen a number of specimens of *Distoma hepaticum*; the liver was taken from the body of a countryman. The abscesses, which are due to the presence of these parasites, appear to be usually small and multiple. This condition is an extremely rare one, and when present it does not appear to be possible to distinguish it from other varieties of multiple small abscesses.

(*d*) *Coccidia.*—According to the researches of Podwyssozki,[3] coccidia may very rarely cause the formation of small localised abscesses in the liver of man. The affection is quite common in rabbits. The parasite is a small unicellular organism, belonging to the group of Sporozoa. Podwyssozki says that the coccidia spores are, in many cases, introduced into the body of man along with uncooked eggs. He asserts also that in one sample of eggs which he examined in the summer, 10 per cent. were affected with the spores of coccidia. The abscesses which are produced by these parasites are small, multiple, and of slow growth. They may cause considerable enlargement of the liver, but the diagnosis of the affection is practically impossible until the contents of the abscess have been evacuated by operation and examined.

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[1] Arnold, *Arch. de méd. nav.*, Paris, Nov. 1889. [2] *Museum, St. Barth. Hosp.*, Spec. 2238.

[3] Podwyssozki, *Vrach*, St. Petersburg, 1890; and *Centralbl. f. klin. Med.*, Bonn, 1890, No. 48, s. 867.

4. *By direct extension from inflammatory foci in adjacent tissues.*—Inflammatory and suppurative processes in the neighbourhood of the liver may, by direct extension, involve the liver itself and give rise to the formation of an abscess. Thus any form of localised perihepatitis, such as subphrenic abscess, an empyema of the base of the right pleural cavity, an empyema of the gall bladder, a localised purulent peritonitis, or suppuration in the region of the right kidney, may each be the immediate cause of an abscess of the liver. A tubercular cavity in the base of the right lung has been known to cause the formation of an abscess of the upper portion of the right lobe of the liver, by obliterating the lower part of the pleural cavity and extending through the diaphragm to the underlying portion of the liver.

5. *Abscesses of pyæmic origin.*—These abscesses are in nearly every case multiple, and they result from a variety of pathological causes and conditions (Fig. 11). The essential factor in the establishment of the affection, in a considerable proportion of cases, is the conveyance to the liver, by one of its blood vessels, of colonies of micro-organisms which are associated with, and the cause of, a suppurative process in some other part of the patient. These micro-organisms can reach the liver by means of the portal vein, the hepatic artery, and the inferior vena cava.

(*a*) *The portal vein.*—Any process of suppuration in connection with the anatomical structures from which blood is taken to the liver by the portal vein, may be the immediate cause of an abscess of the liver. Ulcers of the stomach and duodenum, which are either simple or malignant in character, may be the cause of an embolic process, and become the starting-point in the development of an abscess in the liver. In the same manner ulcerations in any part of the small or large intestine may be followed by the same result. Inflammatory processes in or around the vermiform appendix are especially liable to lead to the development of an abscess. Abscesses which are primary in the spleen and pancreas have been known to cause a similar condition of the liver. Dysenteric ulcers of the large intestine give rise to abscesses of the liver which are often single, or possibly there may be two or more. Operations for hæmorrhoids, rectal prolapse, or for cancer and other affections of the pelvic viscera, have been directly followed by hepatic abscess. Localised peritonitis in the pelvis, especially after a septic labour, is liable to give rise to the same condition. Septic inflammation of the stump of the umbilical cord and the umbilical region have caused hepatic abscess in infants. The occurrence of a gastro-intestinal catarrh, in which there has been no apparent abrasion of the mucous membrane, has been immediately followed by the development of suppurative hepatitis. The simple operation of ligature of piles has been known in several instances to be the cause of an abscess of the liver, and operations upon the urinary bladder from the perineum have had the same sequel. It is probable that in all these cases septic emboli, which consist of colonies of some variety of the micro-organisms of suppuration,

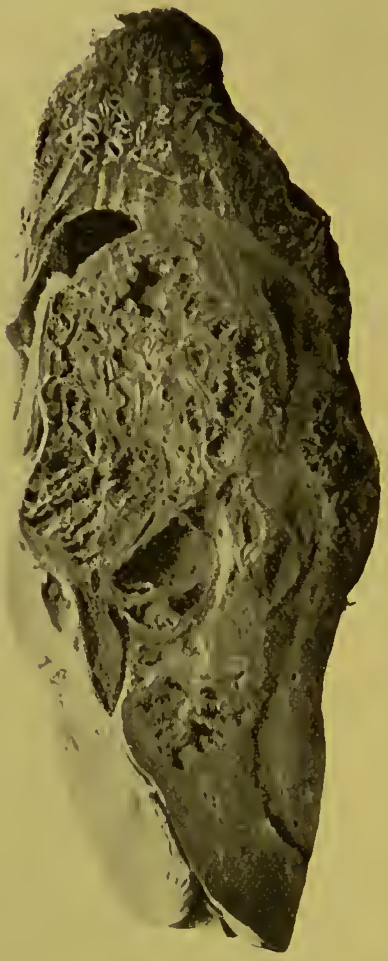

FIG. 11.—Pyæmic abscess of the liver. Section of a liver, diaphragm, and lower portion of right lung. The liver substance is riddled with numerous cavities of varying size, which have destroyed a considerable amount of the hepatic substance. These cavities were originally filled with thick mucoid pus. The suppuration had extended upwards, leading to the formation of a sub-diaphragmatic abscess and an empyema of the right pleural cavity. This condition had followed a perforation of the vermiform appendix, caused by a pin. Before death the seventh rib was resected so as to afford an outlet for the pus.

have passed from the seat of ulceration into the radicles of the portal vein, and have been carried by the blood stream to the liver, where they have been arrested in the portal capillaries, and then by their growth and multiplication have caused inflammation and localised necrosis, which has terminated in the formation of one or more abscesses. It is not clear how these colonies gain an entrance into the lumen of a blood vessel in the case of simple catarrh, but possibly there may be in this condition small abrasions of the mucous membrane which have not been recognised. The micro-organisms which have been met with and described are those of ordinary suppuration, such as the pyogenic streptococci and staphylococci, and also the *Bacterium coli commune.* In hepatic abscesses of dysenteric origin an organism has been met with which is called the amœba coli, but the exact connection of this micro-organism with the suppurative processes has not been definitely established. No micro-organisms have been detected in some cases of hepatic abscess, even after the most careful examination.

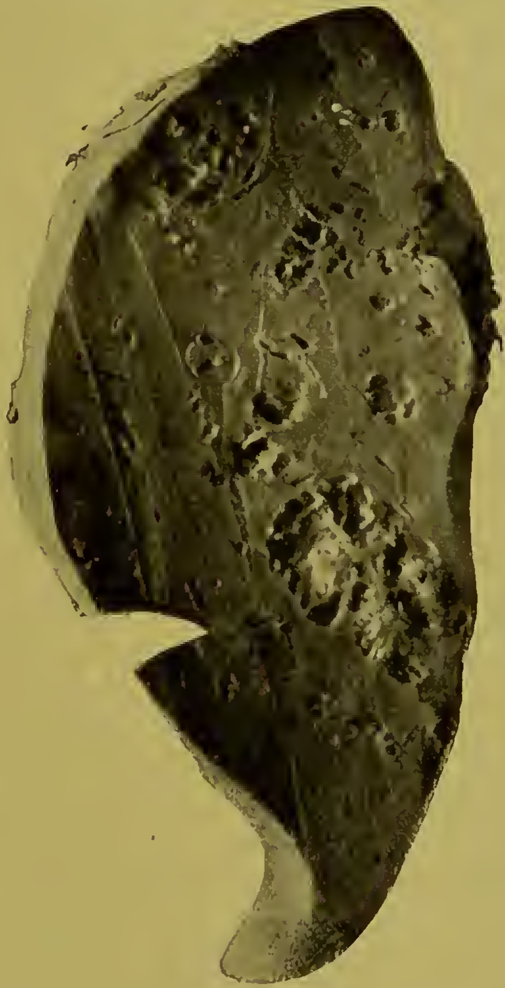

FIG. 12.—Pylephlebitis. Section through the right lobe of a liver which was the seat of a septic pylephlebitis, secondary to an affection of the vermiform appendix. Numerous small abscesses are seen on the surface of the section, situated along the course of the branches of the portal vein.

(*b*) *The hepatic artery.*—When septic emboli reach the liver by means of the hepatic artery, they usually come from some distant focus of disease, and not from any of the structures within the area of the portal vein. Head injuries, which have become the seat of a septic process, are very frequently followed by the development of metastatic abscesses in the liver. The septic emboli from the cranium in these cases must pass through the capillaries of the lung before they obtain an entrance into the main arterial system, whence they pass into the hepatic artery and are carried to the liver, where they are arrested in some of the hepatic capillaries. In some of the cases there are no metastatic abscesses in other organs, but in many it is found that the lungs are also the seat of similar abscesses. Other parts of the body, such as the spleen, kidneys, and brain, may also become the seat of these secondary abscesses. The liver and the lungs, however, are the organs which are the most frequently involved. It has been the subject of much speculation and controversy as to why septic emboli pass from the cranium and other organs, when they are affected with septic inflammations, through the lungs, and are not arrested there, or, if they are arrested there, they do not cause the development of metastatic abscesses. No clear explanation of this pathological condition has as yet been given. It may be possible that the micro-organisms which cause the abscess in the liver will not grow and multiply in the lung tissue, owing to the large amount of oxygen which is always present in these organs. No one has demonstrated, however, that the micro-organisms which are found in abscesses of the liver, due to septic emboli from a distant source, and not associated with abscesses in the lungs, are different from those which are found when the abscesses are present in both the liver and lungs or other organs. Septic inflammations in connection with diseases of bone are not uncommonly the cause of liver abscesses, the emboli being carried to the organ by the hepatic artery. The various forms of acute infective periostitis and osteomyelitis, as well as the septic affections which involve the portions of bone enclosing the organs of hearing, are especially liable to be followed by these sequelæ. A case has been described by Fontän,[1] in which an ordinary boil in the temporal region was followed by the development of an abscess of the liver, and the *Staphylococcus pyogenes aureus* was found both in the boil and in the hepatic abscess. Ulcerative endocarditis has been the cause of a secondary abscess of the liver in a certain number of cases. Thierfelder,[2] Meyer,[3]

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[1] Fontän, *Semaine méd.*, Paris, 1893.

[2] Thierfelder, "Ziemssen's Handbuch," Bd. vii.

[3] Meyer, "Ueber endocarditis ulcerosa," Zurich, 1870.

Chvostek,[1] and Bückling[2] have described such cases. Forty-eight fatal cases of ulcerative endocarditis are recorded in the statistical tables of St. Bartholomew's Hospital for the years 1885–1894, and of those cases which were examined post-mortem, abscesses of the liver were found to be present in only one case, and in this there were also abscesses in other viscera. Gangrene of the lung, purulent bronchitis, and tubercular disease of the lung, in which the caseous portions have undergone disintegration, have all been followed not unfrequently by secondary abscesses in the liver, the septic emboli having been carried to the liver by the branches of the hepatic artery. In the tubercular cases the abscesses in the liver may be either tubercular in nature, or, as more frequently happens, they may contain the micro-organisms of suppuration. Ross and Osler[3] have described a case of aneurism of the hepatic artery, which was followed by the development of numerous secondary abscesses in the liver, owing to the interior of the aneurismal sac becoming the seat of a septic process, and septic emboli being detached therefrom and carried thence to the liver by the hepatic artery. Chronic pyæmia, which is characterised by the appearance of abscesses in various parts of the body, frequently affects the liver; and in nearly all cases which are fatal, this viscus sooner or later becomes the seat of abscesses. Patients who are the subjects of septic thrombosis of the lateral sinus not uncommonly develop signs of secondary abscesses in the liver. In two cases of this kind which I had recently under treatment, both patients died, and in each abscesses were found in the lungs and liver.

(*c*) *The inferior vena cava.*—Some observers, as Magendie and Meckel, have asserted that a septic infection may spread backwards from the blood in the right auricle, along the inferior cava and the hepatic veins to the liver tissue, and give rise to the development of abscesses, the manner of extension apparently taking the form of a thrombus in the veins. The septic material in these cases reaches the right auricle by veins which return blood from other septic foci. There does not appear to be any definite evidence that this is a method by which septic material can reach the liver and cause hepatic abscesses, and from a practical point of view it can be disregarded. Some surgeons have maintained, but without sufficient reason, that abscesses of the liver which follow suppurating head injuries, and thrombosis of the various cranial venous sinuses, may arise in this way, especially when the lungs are not simultaneously affected.

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[1] Chvostek, *Wien. Klinik*, 1881.

[2] Bückling, Inaug. Diss., Berlin, 1868.

[3] Ross and Osler, *Canada Med. Journ.*, Montreal, vol. vi. p. 1.

(*d*) We have already seen, in the chapter on the functions of the liver, that the liver plays an important part in destroying or rendering innocuous the toxines and ptomaines, which are produced by the growth and activity of the various micro-organisms which are concerned in the processes of suppuration. It is possible, when an excessive amount of these substances is produced, that the cells of the liver may be overworked in their attempts to destroy them, and, as a result, their vitality may be so much impaired that they become the seat of growth of suppurative micro-organisms, which have been deposited from the blood either of the portal vein or the hepatic artery. If this is found to be true, it will afford an easy explanation of the fact that, in some cases, abscesses occur only in the liver in certain varieties of septic affections, especially in head injuries.

6. *In connection with acute specific fevers.*—The liver has been found to be the seat of an abscess in a few cases of typhoid fever. According to Romberg, this condition can arise in three different ways—

(*a*) *By extension along the bile ducts.*—An inflammation and ulceration of the biliary ducts or gall bladder, which has been caused by an extension of the typhoid bacillus to these structures, is met with in very exceptional cases of typhoid fever. When it occurs, the ulcerative process may, by direct extension, spread to the adjacent portion of the liver and be the exciting cause of an abscess. Klebs[1] has described a case of this kind in which the ulceration involved the intra-hepatic ducts.

(*b*) *As the result of a suppurative pylephlebitis.*—The mode of origin in this class of case is similar to that which has been described in connection with ulcers of the intestine and portal vein pyæmia. The septic material obtains an entrance through the tissues in the floor of the typhoid ulcers, and is carried by the portal vein to the liver. In a case of this kind recorded by Romberg,[2] the pus in the liver contained staphylococci. Bückling,[1] Tungel,[2] and Bernhard[3] have described similar cases. Schlier[4] and Futtercr[5] have discovered colonies of the typhoid bacillus (Eberth) in the biliary ducts.

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[1] Klebs, "Handbuch f. Path. Anat," 1868.

[2] Romberg, *Berl. klin. Wchnschr.*, 1890, No. 9.

(*c*) In the third class of cases are included those abscesses of the liver which are supposed to be due to an infection from a localised suppuration occurring in the course of an attack of typhoid fever. Chvostek[6] and Leudet[7] have described cases which have followed perichondritis and necrosis of the laryngeal cartilages, occurring as the result of typhoid fever. Louis[8] has recorded a case in which the abscess followed a suppurative condition of the parotid gland and the submaxillary region. It is probable in these cases that the formation of an abscess in the liver is due to absorption of septic material from the typhoid ulcers in the intestine, although it is possible that the septic material may have the origin attributed to it by Romberg.

The affection of the liver in most of the recorded cases appears to have developed in the later stages of the fever. In one of the cases mentioned by Bcrtrand and Fontän[9] the affection was associated with the onset of a typhoid state.

The occurrence of this condition in the course of typhoid fever is very rare; and, according to Langenbuch,[10] only about twenty cases has been placed on record.

Influenza appears to be almost the only one of the other acute specific fevers which has given rise to hepatic abscess. Cimbali[11] has recorded the case of a man who died from an abscess of the liver which followed an attack of this affection.

In the Museum of Guy's Hospital[12] there is a specimen of a liver containing an abscess which occurred as the result of an attack of scarlatina.

7. *Tropical abscess.*—Tropical abscess of the liver is the term which is applied to a variety of hepatic suppuration which

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[1] Bückling, Inang. Diss., Berlin, 1868.

[2] Tungel, *Klin. Mitth. v. d. med. Abth. d. Allg. Krankenh. in Hamburg*, 1864.

[3] Bernhard, *Jahrb. f. Kinderh.*, Leipzig, 1886, s. 303.

[4] Schlier, *München. med. Wchnschr.*, 1891.

[5] Fütterer, *ibid.*, 1888, No. 19, s. 317.

[6] Chvostek, *Allg. Wien. med. Ztg.*, 1866, No. 37.

[7] Leudet, Clinique médicale, Paris, 1874.

[8] Louis, "Recherches anatomiques, etc., sur fièvre typhoide," Paris, 1841, vol. i. p. 118.

[9] Bertrand et Fontän, "L'Hepatite Suppurée,' Paris, 1895.

[10] Langenbuch, "Deutsche Chirurgie," Lief. 45 *c*, Theil. 1.

[11] Cimbali, *Sperimentale*, Firenze, 1890.

[12] *Guy's Hosp. Mus.*, Spec. 1294.

occurs for the most part, although not entirely, in people who live in tropical and subtropical regions, or who, at some time, have lived in hot climates. The abscesses are either single, or not more than two or three in number. Fig. 13 is an illustration of a large single abscess.

*Geographical distribution.*—The disease appears to exist as an endemic affection in many countries which lie within 45 degrees north and south of the equator, whilst those cases which occur in more temperate climates are of a sporadic character. In Europe the disease occurs most commonly in those countries which lie on the northern coast of the Mediterranean. The southern parts of Spain, France, Italy, and Greece, together with the islands which lie in the Mediterranean (Sardinia, Sicily, Malta, the Balearic Isles, and the Ionian Islands) are the places in which the disease occurs as an endemic affection. It has been said by some authors that no cases have occurred in England except in people who have been in hot climates. This is probably incorrect. According to Hilton Fagge,[1] between 1860–1880, there were fifteen fatal cases of large single abscess (one was double) in Guy's Hospital, and in these cases in five only was there a history that the patients had lived out of England. In most of the remaining ten it was definitely stated that they had never been out of England. A

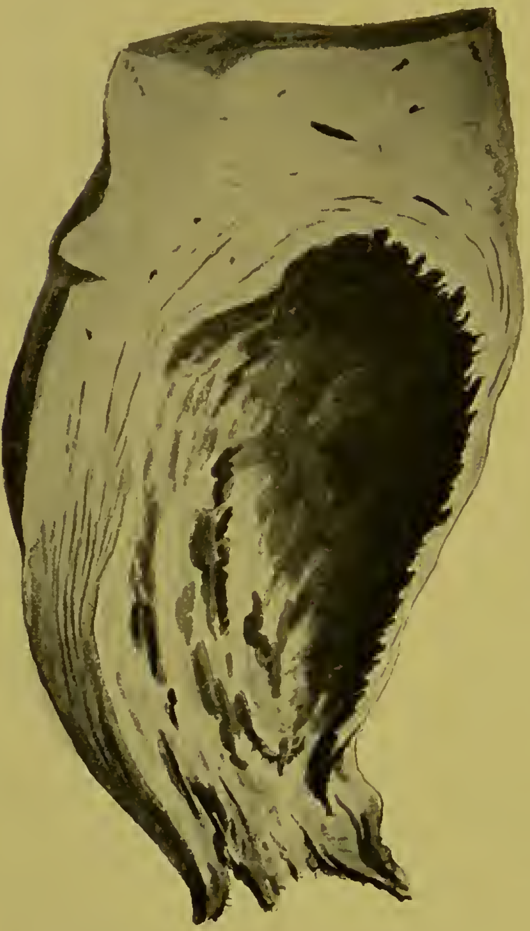

FIG. 13. A large single abscess of the lower portion of the right lobe of the liver. The volume of the liver is only slightly enlarged, although there is considerable destruction of the hepatic tissue.

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[1] Hilton Fagge, "Principles and Practice of Medicine," vol. ii.

patient whom I have seen in St. Bartholomew's Hospital died from a large single abscess of the liver, and he stated that he had never been out of England, and also that he had never had any dysenteric symptoms. Post-mortem, several small dysenteric ulcers were found in the colon. Similar cases have been met with in other places in Northern Europe. From these facts it seems that cases of true tropical abscess can occur in England, and other places with a temperate climate. In Asia the disease is endemic in India, Burmah, Southern China, Southern Japan, the East Indies, especially Java, Sumatra and Borneo, Ceylon, and the southern parts of Arabia and Persia, especially along the coasts of the Red Sea and the Persian Gulf. Fayrer [1] says that, between the years 1850–1879, 2·19 per thousand on an average died each year from hepatic abscess among the British troops, the mean strength during the period mentioned being 57,742 men. The mortality varied in the different presidencies. In Madras it was 3·31; in Bengal, 2·04; and in Bombay, 1·11, per thousand men. From these observations of Fayrer, and also those of Chevers,[2] it seems that the disease is more frequent in Madras, especially on the Coromandel Coast and in the Eastern Ghats. In Bombay it is most frequent in the Ghat Mountains, and in Bengal in the

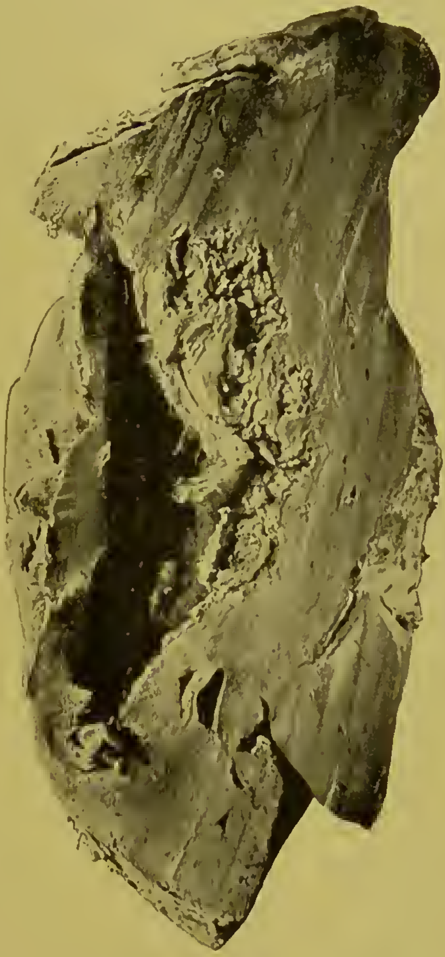

FIG. 14. Large single abscess of the liver. A liver containing a large abscess situated in the right lobe near the convex surface. The walls of the abscess are irregular, and it has penetrated for some distance into the substance of the organ, causing destruction of the hepatic tissue, so that its internal aspect is rough and shaggy. The abscess communicated with a circumscribed portion of the peritoneal cavity. In the transverse colon the scars of three ulcers are visible.—*St. Barth. Hosp. Museum.*

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[1] "Hygiene and Diseases of Warm Climates, 1893, p. 648 *et seq.*

[2] Chevers, *ibid.*

North-West Provinces. (Compare Hirsch, vol. iii.) These statistics apply only to the British troops, and not to the native population. According to Morehead,[1] the admissions for hepatitis during the period of six years at the European Civil Hospital of Bombay averaged 3·7 per cent., and at the Native Hospital, 1·5 per cent., of the total admissions. Waring[2] says that abscess of the liver is met with in a considerable number of cases in the native and foreign population, although not so frequently as among the British troops. In Ceylon, according to the observations of Marshall,[3] the disease is as common in the English troops as it is in India. In Africa the disease is met with in the countries which form the coast of the Mediterranean from Morocco on the west to Egypt in the east. In Madagascar, Mozambique, Mauritius, Réunion, Senegambia, the Slave Coast, the Gold Coast, and Fernando Po, the disease is said to be almost as frequent as in India; whilst on the coasts south of these places it occurs, but much less commonly. In America, the affection is said by most observers to be quite rare in the West Indies, and in the United States it is very rarely seen. It is very common in Chili, especially in the north, and it is of frequent occurrence in Panama, Costa Rica, Guatemala, Salvador, and the western coast of Mexico, whilst on the eastern coast of Mexico it is less frequently met with. In the Western Hemisphere, the northern coast of the Gulf of Mexico forms the limit of the disease as a widespread affection. (Hirsch.[4]) In Australia hepatic abscess is met with, but far less frequently than in India.

*Predisposing causes.*—The predisposing conditions of tropical hepatic abscess are fairly numerous, and deserve careful attention.

(*a*) *Climate.*—It has been shown by Mouat[5] and other observers, that the frequency of the occurrence of tropical abscess of the liver does not depend entirely upon the temperature alone, but that it varies to a considerable extent in tropical places which have approximately the same mean annual temperature. In Algiers, Mauritius, Chili, where the climate is moderately mild, the affection is far more prevalent than in such places as

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[1] Morehead, "Clinical Researches on Disease in India," 1856.

[2] Waring, "Statistics and Pathology of Abscess in the Liver," 1854.

[3] Marshall, "Notes on Medical Topography of Ceylon," London, 1821.

[4] Hirsch, "Geographical Pathology," vol. iii.

[5] Mouat, *Madras Quart. Med. Journ.*, 1839.

Jamaica, Southern China, and Guiana, where the temperature is much more tropical in character. In the North-Western Provinces of India, and the higher parts of Madras, hepatic abscess is more frequent than in Lower Bengal and Bombay, where the climate is hotter. The rainy and cold seasons appear to be the part of the year when the greatest proportion of cases occur. Out of 243 deaths from abscess of the liver, which have been analysed by Waring, 101 happened in the cold season, seventy-nine in the rainy season, and sixty-three in the hot season. It seems from these facts, and the recorded observations of many other writers, that the affection commences in the greatest percentage of cases when the daily variations of the temperature are the most considerable, that is when cold nights follow very hot days. When we discuss the relation of tropical abscess of the liver with malaria, it will be seen that the season of greatest prevalence of the two affections is not quite the same. In general terms it can be stated that the disease is most prevalent when the atmosphere contains the greatest amount of moisture, and the daily variations of temperature are the most marked.

(*b*) *Locality.*—Some authors have maintained that tropical abscess of the liver is more frequently met with in low-lying marshy regions, and in those countries which have low, flat coasts, than in elevated mountainous places and countries with steep coasts, but there does not appear to be very much evidence in support of this statement. In Madras and Bombay the disease is more common in the elevated regions than in the low-lying plains and on the coasts.

(*c*) *Race.*—There is no doubt that the white members of the population, that is to say Europeans, are most frequently the victims of the disease in all countries in which tropical abscess of the liver occurs. According to the statistics which have been collected, concerning the prevalence of the affection in the army in India, the ratio of the percentage of Europeans to natives affected is from one to a little over two. A similar proportion has been observed in other countries where the disease is endemic, but according to Hirsch,[1] the natives of these countries, especially negroes, are more frequently the subjects of the affection than the natives in India. People who have recently arrived in a tropical country from a temperate one are more liable to be affected than those who have lived in a hot climate for some time.

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[1] Hirsch, "Geographical Pathology," vol. iii.

(*d*) *Sex.*—The great majority of cases of tropical abscess of the liver occur in the male sex. In 300 fatal cases collected by Waring,[1] 291 were males and nine females. Of these latter, three were Europeans and six native Indians. De Castro[2] tabulates 170 cases occurring in Egypt, and among these eight were females. Zancarol[3] has recently published a record of 157 cases, which comprised 145 males and 12 females. It is evident from these statistics that many more males were attacked than females.

(*e*) *Age.*—Tropical abscess of the liver does not occur in young children, and in old people it is only occasionally met with. Rouis[4] says that amongst soldiers the most common age is between 23 and 27, and in civil life between 30 and 45. Poiret gives the years between 20 and 25 as the most frequent.

(*f*) *Constitution.*—The affection seems to be the most common in persons of a strong constitution. Saux says that out of fifty-two cases forty-seven were strong and healthy previously, and Rouis asserts that in 116 patients 102 were of good constitution.

(*g*) *Mode of life.*—The mode of life has a strong influence in the predisposition to the development of a tropical abscess of the liver. The abuse of alcoholic liquors appears to be of very great importance, and some authors have stated that alcoholic drink constitutes a very important factor in every case of tropical abscess of the liver. This is, however, probably too sweeping a statement, as there are without doubt cases which arise quite independently of alcohol. The number of cases of hepatitis has been said to have diminished during recent years among the soldiers in India and on the West Coast of Africa, and this diminution has been attributed to the more sober habits of the men and the smaller amount of alcohol consumed by them. It is quite possible, however, that this diminution has been partially brought about by improved sanitary conditions and surroundings. Daniell asserts that since alcoholic liquors have become a regular article of commerce among the natives of the West Coast of Africa, hepatitis has become much more prevalent among them. The greater amount of intemperance among males may explain to a certain extent their greater liability to tropical abscess. Injudicious and indigestible food, together with luxurious and idle habits, may be predisposing causes. Bad hygienic surroundings, with such hard work and exposure as is met with in a soldier's life, may also act in the same manner.

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[1] Waring, *loc. cit.*

[2] De Castro, "Des abcès du foie des pays chauds, et de leur traitement chirurgical," Paris, 1870.

[3] Zancarol, "Traitement chirurgical des abcès du foie des pays chauds," Paris, 1893.

[4] Rouis, "Traité pratique des maladies des pays chaud."

*Relation to other diseases.*—(*a*) *Malaria.*—Some observers, such as Haspel,[1] Annesley,[2] and Dutroulau,[3] have thought that an inflammation of the liver leading to hepatic abscess, is one of the manifestations of a malarial infection. When malaria affects the liver, the gland becomes enlarged, and also undergoes a certain amount of sclerosis; but it does not appear that the development of a tropical abscess has been directly induced by the malarial poison. It is, however, possible that by causing sclerosis the malarial poison may act as a predisposing cause in hastening the formation of an abscess. It has been conclusively shown that the countries, or parts of countries, where malarial fevers are the most prevalent, are not those where hepatic abscesses are the most common. In Algiers tropical abscess of the liver is most common in the province of Oran, a region where malaria is not very prevalent; whilst in Constantine (especially at Bona), which is the region where malaria is the most frequent, hepatic abscess is uncommon. In Chili abscess of the liver is a frequent affection, but malarial fevers are unknown. Malarial fevers are very prevalent in the low-lying lands in the basin of the Danube and the Mississippi, but abscess of the liver is almost unknown in these areas. Malarial fevers are most common in the hot seasons, and we have already seen that this is not the time when hepatic abscess is most frequently met with.

(*b*) *Yellow Fever.*—Kallies and Helfft have suggested that yellow fever may act as a predisposing factor in the etiology of hepatic abscess.

(*c*) *Dysentery.*—In a very considerable proportion of cases of abscess of the liver, it is found that the patients have suffered from dysentery. According to Kiener and Kelsch,[4] out of 314 cases of tropical abscess of the liver, 85·5 per cent. were associated with dysentery. Manson[1] says that "it may safely be asserted that in 75 per cent. of cases of hepatic abscess a history of some degree of dysentery—not necessarily of a very urgent character—can be elicited." Hirsch[2] has collected a number of tables relating to death from dysentery, and out of 2377 cases there were 457 cases of concurrent abscess of the liver, being 19·2 per cent. Some authors have said that the hepatic abscess may be the cause of an attack of dysentery, and there is no doubt that in some cases an abscess of the liver has apparently immediately preceded an attack of dysentery. An organism which is known as the amœba coli has been found in the pus of a certain number of these cases. Kartulis[3] found this organism in the pus of several hepatic abscesses, and also in the hepatic tissue forming the abscess wall; whilst Osler[4] found it in the pus removed by operation from such an abscess. The same organism has been found in a large number of cases of dysentery in which the ulcers have been examined, and also in the stools of patients suffering from this disease. It is not clear what is the exact connection between the amœba coli and dysentery and hepatic abscess, but possibly further investigations may throw more light on the subject. Some observers have stated that they have discovered the amœba coli in the fæces of healthy persons.

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[1] Haspel, *loc. cit.*

[2] Annesley, "Diseases of India," 1841.

[3] Dutroulau, "Traité des maladies des Européens dans les pays chauds," Paris, 1868.

[4] Kiener et Kelsch, "Traité de maladies des pays chauds," 1889.

*The micro-organisms of hepatic abscess.*—As we have already seen, there are a number of micro-organisms which have been found in the pus of hepatic abscesses. In those abscesses which arise as the result of pyæmic processes, the organisms of ordinary suppuration have been found. Thus the *Staphylococcus pyogenes albus* and *aureus* have not unfrequently been found in the pus of hepatic abscesses. In other cases *Streptococcus pyogenes* has been apparent, whilst the *Bacterium coli commune* has occasionally been demonstrated. We have seen that the amœba coli has been found alone or accompanied by micrococci in some of the cases of tropical abscess. The pus from an abscess has occasionally been found to be quite sterile and devoid of organisms. When this condition is met with, the absence of organisms is to be explained either by the incompleteness of the examination, or by the assumption that in the earlier stages of the affection they were present, but that at a later period they died, owing to an accumulation of the products of their vitality and growth, and subsequently underwent disintegration. The specific organisms are always present in cases of coccidial disease. In actinomycosis of the liver, an affection which we shall deal with separately, the specific organism of this affection is constantly met with. From these facts it is apparent that an abscess of the liver may be associated with a variety of micro-organisms, the individual form varying to a certain extent with the pathological cause of the disease.

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[1] Manson, "Abscess of Liver," Quain's "Dict. Medicine."

[2] Hirsch, "Geographical Pathology," vol. iii. p. 412.

[3] Kartulis, *Virchow's Archiv*, 1889, Bd. cxviii. s. 97.

[4] Osler, *Centralbl. f. Bakteriol. u. Parasitenk.*, Jena, 1890, s. 736.

*Pathological anatomy of hepatic abscess.*—An abscess of the liver may be single or multiple, as many as ninety having been met with in the liver of the same patient. It is most usual to find a single abscess, or at most not more than two or three, in those cases which are the result of injury, or are included in the list of tropical abscesses. In Waring's list of 300 cases, there was a single abscess in 177 cases, two in thirty-three, three in eleven, four in seventeen, and five in five cases. Rouis, Dutroulau, and Castro give similar tables, and from an examination of all of these it appears that in tropical cases the abscess is single in from 73 to 75 per cent. of cases. Some of the cases which are due to gall stones or ascarides, or which arise by direct extension from neighbouring foci of suppuration, have only a single abscess, or not more than two or three. Abscesses of the liver which are due to other causes, in the great majority of cases are multiple. Fig. 11 shows a section of a liver in which there were multiple pyæmic abscesses following a localised suppuration in the vermiform appendix, as the result of a pin becoming lodged there. An abscess of the liver which is of pyæmic origin is single in a very small number of cases. If a liver is examined post-mortem in the early stages of the suppurative process, one or more small, somewhat circular patches may be seen, of a grey or yellowish colour, and having around them a ring of congested liver tissue. The hepatic cells in the centre of these areas may be seen to be undergoing a process of disintegration, by which means a small cavity is formed which contains pus cells and tissue débris, and is the commencement of the formation of the definite abscess. Several small abscesses of this kind may form in immediate proximity, and as they enlarge they open into one another, so as to form one large abscess cavity. An abscess of the liver may enlarge in two ways. It may either increase in size by a molecular disintegration of the tissue which forms its walls—that is, by a variety of ulceration—or small abscesses may be formed in the hepatic tissue which bounds it; and as these secondary abscesses increase in size they break through into the cavity of the parent abscess and thus become an integral part of it. If the tissue which forms the boundary of an abscess be examined, it will be found in all acute abscesses to be infiltrated with leucocytes, blood cells, and micro-organisms, and it is at the expense of this infiltrated tissue that an abscess enlarges. The internal wall of an acute abscess is usually somewhat irregular, and a number of small portions of necrotic tissue are attached to it. When an abscess becomes subacute or chronic, its internal wall becomes thickened owing to an increase of the fibrous tissue elements, and in some cases the purulent collection becomes almost encysted. The contents of the abscess or abscesses vary considerably. In cases of tropical abscess they are often reddish or red-brown in colour and thick in consistency, the material resembling to a certain extent a quantity of anchovy sauce. The odour of these cases is said to be peculiar and distinctive. Portions of necrotic tissue may be seen in many cases, or small quantities of blood; whilst in others the contents sometimes have the appearance of laudable pus, or the pus may be thin and watery. In the pyæmic cases, the abscesses contain a thick and mucoid substance; but in some cases the pus is more like laudable pus. When the abscess has been caused by a suppurating hydatid cyst, or by the presence of gall stones, or ascarides in the liver substance, then these bodies may be found as part of the contents of the abscess, and in the same manner foreign bodies which have been the cause of the abscess may be present. In a few cases the contents of the abscess have been found to be stained with bile, but this is not of common occurrence. When the purulent material from an abscess of the liver is examined, it is found to contain pus cells, broken-down and disintegrating hepatic cells, blood corpuscles, fatty débris, pigments, and the various kinds of micro-organisms which have been mentioned already as occurring in the different forms of abscess. An abscess not uncommonly forms communications with the different viscera and serous spaces which lie in the neighbourhood of the liver. Some part of the abdominal alimentary canal, or one or other of the thoracic viscera, are most commonly involved in this way. Langenbuch[1] says that in 170 collected cases in which these complications occurred, in seventy-four the abscess burst into the lung, in twenty-six into the right pleural sac, in twenty-three into the peritoneal cavity, in thirteen into the stomach, in four into the pericardium, and in one into the pelvis of the right kidney. Cyr[2] has collected the records on this subject, and he finds that out of a total of 563 cases, fifty-nine opened into the lungs, thirty-nine into the peritoneal cavity, thirty-one into the pleura, thirteen into the colon, eight into the stomach or duodenum, four into the biliary passages, three into the inferior vena cava, two into the kidneys, two upon the external surface of the body, and one into the pericardium. Of this number, 311 were not opened, whilst eighty-three were opened by operation. From these statistics it is evident that the lungs, pleura, peritoneum, and the alimentary canal are the anatomical structures to which abscesses most frequently spread.

The size of hepatic abscesses varies from one which is only a few millimetres in diameter to one containing several litres of pus. In nearly all cases of this affection the liver is increased in bulk. Dutroulau[3] says that in sixty-six cases, which he had observed, the size was increased in fifty-nine, unchanged in five, whilst in two the gland was smaller than normal. Any part of the liver may be the seat of an abscess, but it is found that the right lobe, especially at its posterior and upper portion, is most frequently involved. Waring[4] says that out of 240 cases the right lobe was affected alone in 163, the left lobe alone in sixteen, and both lobes in ten. These statistics relate to tropical abscess only. The right lobe of the liver is four or five times the size of the left lobe, hence it is only natural that this lobe should be more commonly affected.

*Symptomatology.*—The clinical symptoms which result from the presence of the different varieties of abscess of the liver do not differ essentially in their nature, and on this account they can be considered together. Many cases run a latent course, and this is especially the case with tropical abscess. According to Rouis,[5] 13 per cent. of cases of tropical abscess are latent. Many observations have been recorded of cases which were latent for some time, and then terminated with severe symptoms, owing to rupture of the abscess into one of the neighbouring organs, most commonly into the lung or peritoneal cavity. One case has been described by Maclean, in which an old abscess suddenly burst into the pericardium, after the patient had been taking exercise, and terminated fatally. Another case has also been recorded, in which the abscess burst into the pericardium when the patient was straining at stool. When the abdominal region of a patient, who is suffering from an abscess of the liver, is examined, some part of the hepatic area may be seen to bulge somewhat, or present a definite localised prominence. This, in most cases, appears immediately below the right costal margin, either in the hypochondrium or in the epigastric region. When the left lobe of the liver is the seat of the abscess, a prominence may be seen in the left hypochondrium, and extending into the epigastric region; or the lower two or three intercostal spaces of the right side may bulge slightly, so that they are a little wider than usual, and the respiratory movements are restricted or absent in these spaces.

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[1] Langenbuch, *loc. cit.*, p. 276.

[2] Cyr, "Traité pratique des maladies de foie," Paris, 1887. (These statistics include those made by Waring, Dutroulau, Roux, Haspel, and Cambray.)

[3] Dutroulau, *loc. cit.*

[4] Waring, *loc. cit.*

[5] Rouis, *loc. cit.*

Some observers have laid stress upon the appearance of rigidity in the upper portion of the right rectus abdominis muscle, but this condition is not confined to cases of abscess of the liver, and may be met with in any case where there is a suppurative or inflammatory process in the upper portion of the abdominal cavity. Whenever there is a fulness or swelling of the epigastrium and the adjacent portions of the hypochondriac regions in a patient who may be the subject of hepatic suppuration, and especially in those who are emaciated, the probability of an abscess must always be borne in mind when making a diagnosis. The skin over the localised prominence may be slightly reddened, but usually nothing more than a faint œdema can be discerned; but if this can be seen and recognised, it is a fact of much importance, since it points to the existence of pus in the neighbourhood. The patient often complains of pains in the epigastric or right hypochondriac regions, these pains being either sharp and cutting, or more frequently heavy and dull in character, and occasionally amounting to nothing more than a sense of heaviness and uneasiness. When they are sharp and darting, they usually indicate that the inflammatory affection has spread to the peritoneal surface of the liver, causing some perihepatitis. If the abscess is entirely confined to the interior of the gland, no pain of any kind may be noticed.

An enlargement of the liver can generally be made out on palpation of the hepatic region. This enlargement may be either localised or general, most usually the former; it may be considerable or only slight, and it may extend upwards or downwards, or in both directions. The localised swelling, when present, usually feels smooth and somewhat rounded. Occasionally it is possible to detect signs of friction, owing to the inflammation having extended to the peritoneal covering, and so produced rough surfaces which rub together, especially during the respiratory movements, but this friction can only be felt in rare cases. On careful examination, it is sometimes possible to detect fluctuation in the hepatic swelling. When this can be done with certainty, it is definite evidence that the swelling contains fluid, and if there is also local tenderness and pain, or œdema and redness of the overlying tissue, then it is probable that an abscess is present. During the movements of respiration, a swelling, which is either in close connection with the liver or within it, can be felt to ascend and descend synchronously with the respiratory movements. If the skin over a swelling of the liver is red, owing to the abscess pointing in that area, the central portion will usually be soft, and the tissues around hard and indurated. This condition is not common, and is only seen in the later stages of those cases which approach the surface.

Auscultation in the majority of cases is of little value in the diagnosis of hepatic abscess. If the inflammatory process has extended to the surface of the gland, so as to cause perihepatitis, it is possible to hear friction sounds over the region of the liver. In a similar manner, if the inflammatory process extends through the diaphragm and causes a pleurisy, then friction sounds may be heard over the base of the right lung. Crepitations may also be heard in the base of the lung—more often the right—when the inflammatory process has extended to the lung, or perforation of the abscess into the lung has taken place. In those cases in which an abscess has ruptured into the lung, and a portion of the contents has been evacuated, and the space which was occupied with purulent matter becomes filled with air from the lung, it is possible to hear a curious bruit synchronous with the systole of the heart, which is caused by the entrance and exit of air through a small aperture from the lung to the abscess cavity at each contraction of the ventricles of the heart. From a similar reason, it has been said that a succussion splash may occasionally be heard on shaking the patient. The exact area of the hepatic dulness can be definitely mapped out by percussion, except where it passes into the cardiac dulness above, and into the dulness which is present in consolidation of the base of the lung, or into the area of dulness of a pleural effusion.

The enlargement of the hepatic dulness, which is present in cases of abscess, will frequently be found to extend upwards, whilst the lower border of the gland will be found to be more or less normal, and less commonly the hepatic dulness may be increased in a downward direction, or even both upwards and downwards. When an abscess is present, the area overlying it is often found to be tender, and in some cases acute darting pain is induced on percussion. If the normal outline of the liver is found to be altered, this must be regarded as important evidence in making a diagnosis regarding the presence of an abscess, especially if the abnormal part gives signs of fluctuation. In a few cases the lower outline of the liver has been found almost as low as Poupart's ligament, but this is unusual in cases of abscess. Displacements of adjacent viscera may occasionally occur in an abscess of the liver, owing to the local enlargement pushing the viscera aside. The heart may be found to be displaced upwards and to the left, or if the enlargement is chiefly in the upper part of the right lobe it is displaced towards the left alone. The right dome of the diaphragm and lung may be pushed upwards at the same time, or even without any displacement of the heart. The stomach and colon and the right kidney may also be pushed downwards, owing to the enlargement of the liver in this direction. Patients often suffer from pains in the region of the shoulder and over the scapula, and in nearly all cases it is the right scapular region and shoulder; but occasionally the left side is involved, and when this is the case it is said that the left lobe of the liver is the seat of the abscess, as has been demonstrated post-mortem by several observers (Chvostek, Gintrac, Broussais). In some the shoulder pain has been bilateral. The pain in these cases is most intense over the angle of the scapula and at the tip of the shoulder, and it has been supposed to be due to irritation of the branches of the phrenic nerve which supply the surface of the diaphragm and the convexity of the liver. It is said only to occur when the inflammatory process has extended to the surface of the gland, and is more frequently present when the abscesses are multiple and pyæmic in origin than in the single tropical variety. Some observers have stated that it is present only in those cases in which the convexity of the liver is involved, but this does not appear to be correct, since Andral has recorded a case of right-sided shoulder pain which was found to be associated with an abscess situated upon the inferior part of the right lobe. In a few cases paralysis and wasting of the deltoid muscle, and of other of the arm muscles, has followed an abscess of the liver, but the exact connection between them is not clear. Irritation of the phrenic nerve, by a reflex process, seems to be the cause of a short, dry, hacking cough, which occurs in some cases, and has been named "hepatic cough" or "tussis hepatica." This cough is distinct from that which is caused by extension of the inflammation to the lung or pleura, or that which occurs when an abscess has opened into the lung, and its contents discharged into the bronchi and coughed up. The sputum has been said by Councilman[1] occasionally to contain the amœba coli, the presence of which indicates, in his opinion, that the abscess is in close relation to the pneumonic tissue, and that it is the precursor of rupture of the abscess and the discharge of its contents into the lung. When the abscess is large and encroaches upon the thoracic cavity, owing to its extension in an upward direction, a moderate amount of dyspnœa may be induced. When the abscess is situated on the inferior aspect of the gland, the portal vein and the other structures in the portal fissure may be pressed upon, and, as a result, ascites, enlargement of the spleen, and jaundice, may be established.

The structures in the portal fissure or in the gastro-hepatic omentum, however, are very uncommonly obstructed in abscess of the liver. The skin in many cases has a dirty or muddy coloration, which resembles slight jaundice, and the sclerotic has a yellowish tinge. True jaundice only occurs when the bile ducts in the portal fissure are pressed upon. The course of the temperature in cases of abscess of the liver varies very considerably. When the abscess follows an injury, the commencement of the suppurative process will usually be marked by a definite rise of temperature, or even by the occurrence of a rigor, and during the course of the affection the temperature will remain elevated unless a free exit for the pus is established. In those cases which are pyæmic in origin (such as those following affections of the abdominal viscera, after head injuries, and in ulcerative endocarditis), the commencement of the hepatic affection will usually be accompanied by the occurrence of a rigor, and the subsequent course will be similar to that of an ordinary case of pyæmia. The temperature in cases of tropical abscess is usually found to be raised, especially in the evening, but not, as a rule, higher than 102° or 103° F. Rigors have been noted occasionally, but these are not very frequent.

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[1] Councilman, *Brit. Med. Journ.*, London, 1892, p. 67 (Epitome).

Sometimes the temperature has been said not to have undergone any elevation at all, and this especially is the case in those patients in whom the disease runs a chronic or latent course. It is not possible to diagnose a case of abscess from the temperature chart alone, but when this is considered along with the other clinical symptoms and the history, it may afford valuable help. Digestive disturbances are often met with. When the abscess is situated on the inferior surface or in the left lobe, it may press upon the anterior and upper portion of the stomach and be the cause of attacks of vomiting. The appetite is usually impaired, but in some cases it remains good. The urine in those cases in which the temperature is raised is of high specific gravity, loaded with urates, and of dark colour, but the presence of bile pigments is uncommon. The state of the bowels varies a good deal; they may be constipated, or diarrhœa may be a marked symptom, and in other cases these conditions may alternate. When the abscess communicates with some portion of the alimentary canal, large quantities of pus may be found in the stools. In cases of dysentery the stools peculiar to this affection are, of course, met with, and, according to some recent observers, the amœba coli is constantly seen. In all cases of hepatic abscess, especially the non-tropical ones, the symptoms which are due to the presence of an abscess in the liver are liable to be partially masked and modified by the symptoms of the disease of which the hepatic affection is only a secondary manifestation.

*Complications.*—Abscess of the liver is very commonly associated with or liable to be followed by certain complications, the most frequent of which is rupture into one of the adjacent viscera.

(*a*) *Rupture into the stomach or some part of the alimentary* *canal.*—When the abscess bursts into the stomach, it is generally followed by an attack of vomiting, during which the pus is evacuated through the mouth. In most cases the pus is foul-smelling, and contains a quantity of blood mixed with it, or it may contain either a foreign body or a gall stone, or an ascaris, if any of these have been the cause of the formation of the abscess. In a few cases of rupture into the stomach, the pus has passed along the alimentary canal and been evacuated through the anus, after having been partially disintegrated by the processes of digestion. Symptoms of anorexia, and a continual feeling that the stomach is full, are said to precede a rupture into the stomach in many of the cases. Rupture into the duodenum is occasionally met with, and may be followed by vomiting of pus, blood, and bile; or the purulent matters may pass along the intestine, to be evacuated per anum in the form of diarrhœic, pus-containing motions. The opening of a hepatic abscess into the stomach is not very frequent; much more common is bursting into the large intestine, especially into the hepatic flexure and the transverse colon. When this occurs it is usually associated with the occurrence of symptoms of shock, followed by the passage of a considerable amount of pus and blood per anum. An abscess may also open into the small intestine, but this is of very infrequent occurrence. According to Thierfelder,[1] out of 120 cases, thirteen opened into the stomach and thirty-two into the intestine.

(*b*) *Into the peritoneal cavity.*—This is not uncommon in cases of hepatic abscess, and among Thierfelder's cases, twenty-three opened in this way. In Cyr's[2] statistics, thirty-nine cases out of 543 ruptured into the peritoneum. Rupture usually occurs during some muscular exertion such as straining at stool, and in these cases is immediately followed by symptoms of severe shock and the development of acute peritonitis. In some cases, if the abscess is small and chronic, the pus may become encysted and shut off from the remainder of the peritoneal cavity, and so result in the formation of a localised peritonitis. Up to the present time most of these cases have been followed by fatal results, but in the case recorded by Hulke,[3] recovery ensued after a surgical operation.

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[1] Thierfelder, "Ziemssen's Handbuch," 1878, vol. vii.

[2] Cyr, *loc. cit.*

[3] Hulke, *Med.-Chir. Trans.*, London, 1894, p. 81.

(*e*) *Opening of the abscess into the pelvis of the right kidney.*—This condition is very rare, and only about ten cases have been recorded (Waring, Huet, Hashimoto, Colin). When it occurs it is accompanied by signs of diminution in size of the hepatic swelling, and immediately afterwards by the presence of pus, blood, and liver cell débris in the urine. Cases of this kind have terminated favourably in a few instances.

(*d*) *Rupture into the inferior vena cava.*—This is a very rare complication, and when it occurs it is fatal either at once from embolism of the lungs, or later from secondary abscesses. This accident occurred three times in Waring's three hundred cases. A similar result has followed rupture of the abscess into the portal vein, a condition of affairs which has been seen in a few cases.

(*e*) *Rupture into the biliary passages.* — Opening of the abscess into the gall bladder, or more rarely into one of the larger bile ducts, has been met with in only a small number of cases. In a case which has been described by Jubiot,[1] the patient passed a large amount of pus and blood per anum, a short time before death, and when examined afterwards the abscess was found to have opened into the gall bladder. As a result of this form of rupture, an inflammatory condition of the mucous membrane lining the biliary passages may be established, which is associated with symptoms of liver colic and the development of jaundice. These cases are not necessarily fatal; occasionally recovery follows, which was the case in a patient mentioned by Galloupe.[2]

(*f*) *Bursting into the pleura or lung.*—Before either of these complications can occur, it is necessary that the inflammatory process should extend to the convexity of the liver, and thence to the diaphragm, and through this to the pleura or lung, or both. Rupture into the lung is more frequent than rupture into the pleura. In many cases the inflammatory process causes adhesions to be formed between the visceral and parietal layers of the pleura, and in this manner the pleural cavity is shut off, and the abscess makes its way into the lung tissue. According to the tables of Thierfelder,[3] out of 170 cases, twenty-six burst into the right pleural cavity, whilst Rendu[4] thinks that about 5½ per cent. of cases open in this way. In the table of collected cases given by Scheube,[1] out of 563 cases, thirty-one opened into the pleura, and fifty-nine into the lung. The symptoms of this complication are those of a rapidly developing empyema of the right side. It is only very rarely that the left pleura is the seat of rupture of a hepatic abscess, but this may occur when the abscess is seated in the left lobe of the liver, although a case has been recorded by Peacock,[2] in which an abscess of the left lobe perforated into the right pleura. Rupture into the lung is the most common complication, and, according to Rendu, it occurs in a little over 10 per cent. of cases. Among the 170 cases collected by Thierfelder, rupture into the lung occurred in seventy-four. The right lung is the seat of rupture in nearly every case, and the base is the part into which the rupture takes place. It is preceded by a localised pleurisy, which terminates in the formation of adhesions between the base of the lung and the upper surface of the diaphragm. In most cases the rupture opens into one of the larger bronchi in the lower lobe of the right lung, through which the purulent contents of the abscess pass into the trachea, whence they are coughed up and evacuated through the mouth. Rupture into the lung is said to be preceded by premonitory symptoms of cough, and if the base of the right lung is examined with the stethoscope, crepitations or râles can be detected, whilst the sputum may, in the tropical cases, contain the amœba coli. When rupture has occurred, quantities of purulent material mixed with blood corpuscles and liver-cell débris is coughed up. The pus is generally of a very foul odour, and in some cases foul-smelling breath has been noticed to precede bursting of the abscess into the lung. When the abscess cavity has been evacuated, the walls may bleed freely, the blood passing into the bronchus, and thence through the mouth, so as to give rise to the impression that the patient is suffering from hæmoptysis. This condition must be remembered when dealing with cases of apparent hæmoptysis in patients who have been the subjects of an attack of dysentery. After an abscess has been evacuated in this manner, the sputum of the patient may be so dark in colour as to resemble that from a case of pneumonia, and in treating patients affected thus, care must be taken not to make a mistake in diagnosis. For analogous reasons, hepatic abscess must not be confused with pulmonary phthisis. Occasionally the sputum has been noticed to be coloured slightly yellow, owing to the presence of bile, and Wolfes has discovered the presence of sugar in the pus which was coughed up from an abscess of the liver. The course of the disease in patients suffering from abscess of the liver which has burst into the lungs, has often been very favourable; although discharge of purulent material may go on for a very long time. According to Castro[1] a good result follows in 76 per cent. of patients in whom the abscess bursts into the lung. In Castro's statistics the abscesses were of the tropical variety, and in these undoubtedly a good result often follows; but when the abscess is due to a pyæmic affection, the termination is nearly always fatal. Fig. 11 is a drawing made from the liver and lung of a patient who died from a pyæmic abscess of the liver which perforated the diaphragm and opened into the right lung.

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[1] Jubiot, quoted by Langenbuch.

[2] Galloupe, *Boston Med. and S. Journ.*, 1883, p. 271.

[3] Thierfelder, *loc. cit.*

[4] Rendu, *loc. cit.*

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[1] Scheube, "Krankheiten des Warmen Lander," 1896, s. 380.
[2] Peacock, *Med. Times and Gaz.*, London, 1867, vol. ii. p. 611.

(*g*) *Bursting into the pericardium.*—This is fortunately a rare complication, but when it does occur it is invariably fatal. Cases of this kind have been recorded by Christiansen,[2] Mayet,[3] Hambursin,[4] Pimser,[5] etc. It is said by some authors that the condition may be preceded by signs of pericarditis, when the inflammatory process has extended through the diaphragm to the superjacent pericardium. The complication appears to have come on without any recognisable premonitory symptoms, and to have been characterised by symptoms of severe shock, weak and irregular pulse, and signs of fluid in the pericardium, in the majority of those cases which have been placed on record. Death usually follows this condition within twenty-four hours of the occurrence of the rupture. In a certain number of cases, rupture into the pericardium appears to be the termination of an abscess situated in the left lobe. Abscesses in this position, however, are much less frequent than in the right lobe. It seems, therefore, that an abscess of the left lobe is much more liable to be followed by rupture into the pericardium than one which is situated in the right lobe. The aperture of communication between the abscess cavity and the pericardium may be very small, and the purulent matter may consequently only pass slowly into the cavity of the pericardium, in which case the symptoms are not so acute as when the aperture is larger.

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[1] Castro, *loc. cit.*

[2] *Förh. Norske med. Selsk. i. Kristiania*, 1890, p. 211.

[3] Mayet, *Gaz. hebd. de méd.*, Paris, 1873, Nos. 39–42.

[4] Hambursin, *Presse méd. belge*, Bruxelles, 1869.

[5] Pimser, *Wien. med. Wchnschr.*, 1883, s. 1244.

(*h*) *Bursting of the abscess on the surface of the body.*—An abscess of the liver may occasionally point on the surface of the body, and discharge its contents externally. The point of exit of the pus may be in the epigastrium, in the right hypochondrium, or between the ribs through one of the lower intercostal spaces; or in rare cases the pus may track underneath the superficial tissues and open at some distant point, such as the lower part of the abdomen, over the sacrum, in the axilla, or even in the scrotum or thigh. After a liver abscess has opened upon the surface of the body, it may terminate in the development of a fistula, from which bile is discharged and which is liable to persist for a long time. When the abscess tends to come to the surface, it in many cases causes a necrosis of the superjacent portions of the lower ribs.

Symptoms in connection with the general nervous system may develop in the later stages of a case of hepatic abscess. These tend to be of the nature of melancholia and hypochondriasis, or there may be well-marked delirium and coma. They are more common in the later stages of cases which are of pyæmic origin, and are dependent upon pathological conditions of the brain or its membranes. In some cases œdema and thickening of the arachnoid and pia mater have been noticed, in others purulent meningitis has been present, and in others, again, secondary abscesses have been found in some part of the brain. Hammond[1] advises, in cases of hypochondriasis and melancholia occurring in regions where hepatic abscess is common, that the condition of the liver should be carefully examined, and if any doubt exists, that an exploratory puncture with an aspirator should be made. The patient is irritable, and often has fits of depression, without exhibiting definite signs of hypochondriasis or melancholia, in most cases of abscess of the liver.

*Diagnosis.*—In those cases in which the abscess is latent, the diagnosis is impossible until it bursts into one or other of the neighbouring organs, or comes to the surface of the liver and gives rise to definite symptoms. Pain localised in the right hypochondriac region, and associated with pain in the right shoulder or in the right scapular region, together with muddiness of the complexion or slight jaundice, and an enlargement of the liver which can be felt on palpation or recognised by percussion, and the presence of a raised temperature, will suggest the existence of hepatic suppuration. The presence of dysentery, or some septic inflammatory process in connection with one of the abdominal viscera, will help in forming a correct diagnosis. A feeling of weight and fulness in the right hypochondrium, which is associated with an elevated temperature, malaise, and general wasting, together with signs of a localised enlargement of the liver in some direction, will point to the possible occurrence of an abscess of the liver. Jaundice is most common in infective or pyæmic cases, and is said to be due to a general infection of the blood; when it is deep and intense, it may be due to pressure upon the hepatic ducts. If hepatic suppuration has existed for some time, it may cause perihepatitis, which condition will be rendered evident by the presence of signs of friction over the inflamed area. Localised perihepatitis may simulate the symptoms of a hepatic abscess. In these cases the pain is very localised, develops suddenly, and on auscultation a distinct friction sound is heard. There are usually no signs of enlargement of the liver, and the general symptoms are not so severe. The previous history of the patient may afford important evidence of abscess; thus the history of a blow or perforating wound in the hepatic region, or an attack of dysentery, or of some focus of suppuration, especially in the pelvis or cæcal region, would favour the diagnosis of abscess, if there are any symptoms which point to an affection of the liver. The possibility of the occurrence of an abscess of the liver must always be borne in mind when suppurating head injuries are under consideration. In many cases it is impossible to make a diagnosis as to the nature of a swelling in connection with the liver before aspiration. This procedure is justifiable, but arrangements should always be made so that if an abscess is found it can be evacuated by a surgical operation. The nature of the abscess, if present, can often be determined by an examination of the pus which is withdrawn by the aspirator. Thus, if it is due to dysentery, the amœba coli may be demonstrated; if it is due to suppuration in connection with a hydatid cyst, hooklets may be seen; and if it is due to coccidia, these micro-organisms will be found. The pus from a tropical abscess has very often the colour and consistence of anchovy sauce, and that in pyæmic cases is generally thick and mucoid in nature, and contains pyogenic bacteria. In cases of actinomycosis the fungus of this affection can be seen under the microscope, or the yellow granules may be apparent to the naked eye.

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[1] Hammond, *St. Louis Clin. Rec.*, 1878.

*Treatment.*—Whenever the presence of a collection of pus within the interior of the liver has been definitely diagnosed, direct surgical treatment is indicated, and the object of the operative procedure is the evacuation of the purulent matter through an opening upon the surface of the body. A variety of operations have been made use of for this purpose by different surgeons. In former times it was recommended that the pus should be evacuated through the needle of an aspirator, or through a cannula which had been pushed into the interior of the abscess, along with a trocar which was removed. It was found in cases which were treated by this method, that suppuration along the track of the needle or cannula was very liable to occur, and in many cases a leakage of pus into the peritoneum or the pleura followed and set up an attack of acute septic peritonitis or pleurisy, which in most cases proved fatal. On this account it is advisable to regard puncture of an abscess of the liver with the needle of an aspirator or exploring syringe, as a diagnostic measure, or at most an accessory procedure in the evacuation of a collection of pus from within the liver.

In all cases a free opening should be made into the cavity of the abscess, so that the purulent contents can be thoroughly evacuated, and a complete examination made of its interior, and if any secondary abscesses are present they can be made to communicate with the cavity of the one first opened.

Before deciding upon the area which is to be incised, so as to allow of the evacuation of the abscess, the patient should be anæsthetised, and the hepatic area rendered quite aseptic by washing, first with soap and water, then with ether, and finally with a solution of perchloride of mercury. When this has been done, the exact extent of the liver, and the location of any enlargement is made out. If the position of an abscess can be made out in this manner, a point is taken which is nearer the upper margin of the enlargement than the lower, and the needle of an aspirator is pushed inwards until the interior of the abscess cavity is reached. When the needle is felt to enter a cavity, its point is moved about so as to ascertain, as far as possible the size, shape, and extent of the abscess. In every case in which the point of the exploring needle enters a space within the liver, it is advisable to withdraw a small quantity of the contents, so as to ascertain their nature and character, and by this means obtain information which may be of great value during the further treatment. When the exact locality of the abscess within the liver has been made out, a point is selected, which is situated over its most prominent part, and somewhat nearer the upper limit than the lower (and, if possible, immediately below the costal margin), and an incision made through the overlying tissues until the surface of the liver is reached. This incision is best made with a knife, though Zancarol[1] advises that it should be made with a thermocautery. The further stages of the operation depend upon the condition of the surface of the liver and the surrounding structures. In all cases where the visceral and parietal layers of peritoneum in the region of the incision have become adherent, and so cut off the area of the operation from the peritoneal cavity, the incision is deepened through the hepatic substance until the abscess cavity is opened. This incision through the hepatic tissue may be made either with an ordinary scalpel or with the knife of a thermocautery, preferably the latter, since it tends to arrest hæmorrhage from the injured liver.

When no adhesions have formed between the visceral and parietal layers of peritoneum within the area of the incision, the further methods of procedure vary according as to whether it is thought better to shut off the peritoneal cavity or not. It appears to me that the following is the safest course to adopt, and the least likely to be followed by septic complications. The adjacent portion of the peritoneal cavity is packed with flat aseptic sponges, so as to protect the other abdominal viscera, and prevent any of the contents of the abscess from infecting the exposed area of peritoneum. Then the cavity of the abscess is opened by making an incision through the liver substance with the knife of a thermocautery, or an ordinary scalpel; when the cavity of the abscess has been opened, the finger of an assistant is introduced, and the liver hooked forwards and held in contact with the parietes. The contents of the abscess are evacuated, the interior of the cavity thoroughly irrigated with an antiseptic solution (hyd. perchlor. 1–1000), and then the internal surface swabbed by means of sponges on holders. When this has been done, a long strip of iodoform gauze is packed in the interior of the abscess so as to fill the entire cavity. The exposed surface of the liver and the adjacent portion of the peritoneum should then be thoroughly irrigated and cleansed from blood, purulent matter, or débris ; and, finally, the margins of the hepatic wound are united to those of the parietal incision by a ring of silk sutures, inserted according to the method described in the operation of "hepatotomy." A dry antiseptic dressing is applied and fixed in position with a bandage. The antiseptic gauze tampon should be allowed to remain unchanged for about two or three days, in order to permit the formation of adhesions between the approximated layers of peritoneum. After this time it is advisable to change the dressing daily, and on each occasion to irrigate the interior of the abscess cavity. Some surgeons have advised that this operation should be performed in two stages, so that adhesions may form between the surface of the liver and the abdominal wall before the abscess is evacuated ; but in order to effect this it is necessary to delay the evacuation of the purulent matter from the abscess for four or five days, a proceeding which appears to me to be somewhat unsurgical.

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[1] Zancarol, *loc. cit.*

In many cases of abscess of the right lobe of the liver, it is necessary to perform the operation through an incision in the thoracic wall, on account of the high level at which the purulent collection is located, and the difficulty which is experienced in dealing with it from an incision in the abdominal wall. The details of the operation through the chest wall are discussed in the chapter on Operations. It is advisable in all cases in which an incision is required in the substance of the liver, when this organ is situated at some distance from the surface, to incise the liver tissue with the knife of a thermocautery, since this procedure tends to avoid or prevent the occurrence of hæmorrhage and the passage of purulent matter into any of the small hepatic veins. On this account it is recommended that the incision in the liver, in cases of hepatic abscess which are being treated through a thoracic incision, should always be made with the knife of a thermocautery. An abscess of the liver may be situated either in the right or left lobe, or it may involve both. When situated in the right it may be necessary to carry out the evacuation, either by an abdominal or a thoracic incision, but when it is located in the left lobe the operation can always be performed through an incision in the abdominal wall. When an abscess of the liver communicates with the right pleural cavity, it is advisable to make a very free opening into the chest by resecting portions of two or even more ribs, and through this opening to evacuate the collection of pus within the liver, and to drain both the pleural space and also the pus-containing space in the liver. If it is found that the abscess does not communicate with the pleural cavity, and there is at the same time an empyema of the right pleural cavity, it is recommended that the two pus-containing spaces should be opened, evacuated, and drained through separate incisions. In all cases the empyema is treated by incising and resecting one or more ribs, whilst the hepatic abscess is treated through an incision which may or may not require resection of a portion of rib, according to the locality of the pus within the liver. When the abscess has burst into the lung, and the contents are evacuated by the mouth, it is not necessary to perform an operation, unless there are signs of considerable lung infiltration, and the patient suffers from the cough which is induced, in which case it is advisable to drain the abscess through an incision in the chest wall. The abscess is situated in the upper and posterior portion of the liver in most cases of this kind, and it can be reached most easily through an incision in the lower and posterior part of the thoracic wall. If the abscess communicates with the pericardium no operation appears to be of any value, since in all instances of this complication a fatal termination has resulted. When the abscess has burst into the peritoneum, two distinct pathological conditions may be brought about. In the first, adhesions are formed which shut off the pus from the general cavity of the peritoneum, and a localised encysted abscess develops; whilst, in the second, no such favourable condition follows, but, instead, the purulent matter infects the entire peritoneal cavity, and a general acute septic peritonitis results. In the first of these conditions the course of treatment which should be adopted is similar to that of an uncomplicated abscess situated in the inferior portion of the liver; that is to say, the overlying abdominal wall should be incised, and the abscess evacuated and drained in the usual manner. In the second class of case, surgical treatment does not offer much relief, since nearly all cases of this nature terminate fatally. The only course, however, to adopt which offers any chance of cure, is to open the peritoneal cavity by an abdominal incision in the region of the hepatic abscess, and through this opening to evacuate the abscess, and also wash out the general peritoneal cavity with an antiseptic solution, so as to remove the products of the septic peritonitis as completely as possible, and then to establish free drainage. It occasionally happens that an abscess of the liver bursts into some part of the alimentary canal, usually the duodenum or the stomach, and the purulent contents are discharged into the lumen of the perforated organ. In these cases septic matter usually passes from the alimentary canal into the abscess and keeps up the inflammation. The safest course to adopt in such cases appears to be to establish drainage of the abscess through an incision in the overlying portion of the abdominal wall.

In all cases of hepatic abscess which have been submitted to an operation, it is necessary, in addition to the local measures, to maintain the patient's general condition by the administration of plenty of easily digested and nourishing food, with stimulants, if it is thought that they are requisite. Opium in small and repeated doses may be required to alleviate pain and induce sleep. Bleeding or depleting measures of any kind are to be strongly deprecated.

*Prognosis.*—The prognosis in cases of abscess of the liver differs very considerably in the individual cases. When the abscess is single (or there are not more than two or three), the result is much more likely to be favourable than in those pyæmic cases where there are a number of small abscesses. According to the statistics which have been collected by Zancarol, the mortality of cases which have been treated by puncture with a trocar or an aspirating needle has been 80 per cent.; in those which have been treated by incision with the knife, 71 per cent.; whilst in those which have been treated by him with the thermocautery it has fallen to 50 per cent. In Zancarol's cases the proportion of multiple non-curable abscesses was about 40 per cent., and that of single abscesses which ought to have been cured was about 60 per cent. Zancarol's list comprises 157 cases, of which seventy-seven were cured, seventy-seven were fatal, and three left the Hospital before the result was known.

# CHAPTER VII.

## TUBERCULAR ABSCESS OF THE LIVER.

TUBERCULAR disease of the liver and the biliary system is a rare affection. It occurs as a localised manifestation of a general miliary tuberculosis, but in this case it is of little surgical interest, as it is not possible to adopt any measures for its treatment beyond those medical means which are made use of in the treatment of the general disease. It also occurs as a local disease of the organ, and is due to the presence of deposits of the *Bacillus tuberculosis* in the hepatic tissue. This form of the disease occurs much more commonly in children and young people than in adults, and when it exists it usually gives rise to the development of a localised abscess which is tubercular in character. Two varieties of this form have been met with, and have been described by various observers. The first of these is characterised by the fact that the tubercular process is confined to the interior of the organ and terminates in the formation of an intra-hepatic abscess; whilst in the second the pathological condition involves the hepatic substance in the neighbourhood of the surface of the gland, and at the same time extends to the capsule and the adjacent tissues, so as to cause the development of a perihepatic abscess. The perihepatic abscess is a much more common result of a localised tubercular process in connection with the liver than the intra-hepatic variety. These tubercular affections of the liver in occasional cases may be the sole localised manifestations of the disease, but it is found that in the greater number of instances they only constitute a small part of the pathological condition. The intra-hepatic abscesses when present are usually of small size, but in exceptional cases they have been known to attain a diameter of several inches. Fig. 15 is an illustration of a specimen of a large circumscribed tubercular abscess of the liver which is in the Museum of St. Bartholomew's Hospital. The abscess is quite localised, and the internal surface is covered with shreds of partially organised lymph, and in this tissue the tubercle bacillus was found. The specimen was obtained from a patient who died from phthisis. In the same museum there is a second specimen, in which the left lobe contains a number of tubercular masses, the largest being about 2 in. in its longest diameter, and showing signs of breaking down in several places. The patient from which this specimen was obtained was a boy who suffered from amyloid disease of the abdominal viscera, as well as presenting other signs of tubercle. In most cases of this kind the abscess in the interior of the liver is not associated with special symptoms dependent upon its presence, and its existence is only discovered on making a post-mortem examina-

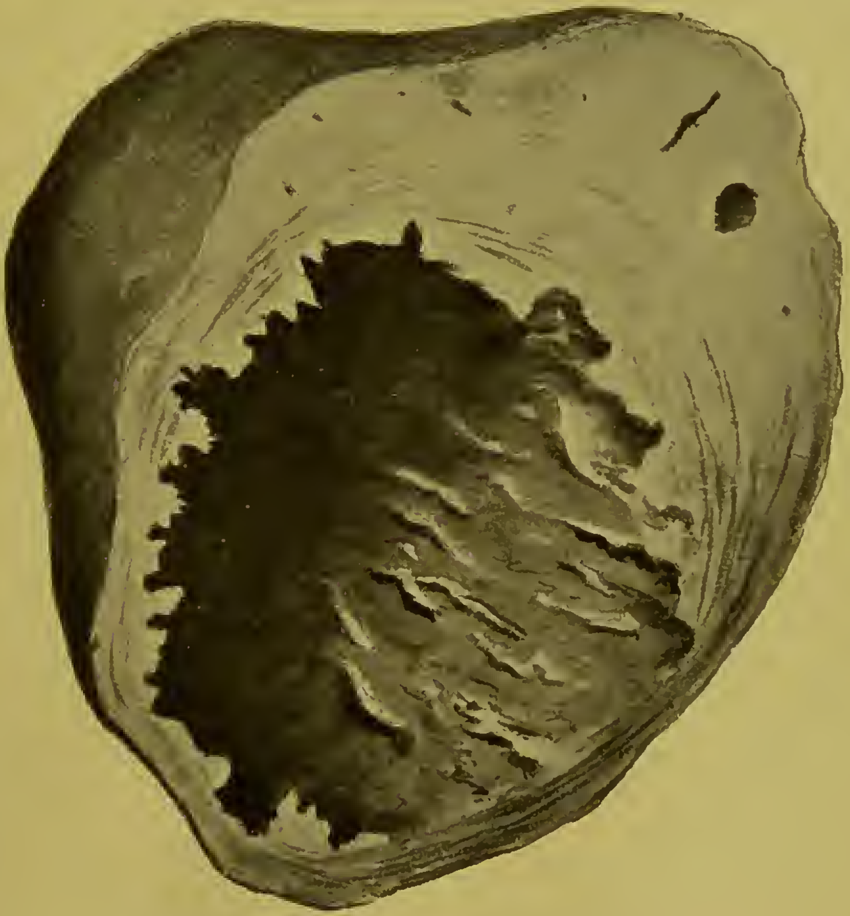

FIG. 15.—Section of a portion of liver containing a circumscribed tubercular abscess. The abscess wall is covered with shreds of partially organised lymph. From a patient who died of pulmonary phthisis.—*St. Barth. Hosp. Museum*, Spec. 2196 *a*.

tion, after death has occurred from disease of some other organ. The perihepatic variety of tubercular abscess, which is the more common, usually commences as a localised tubercular affection of some part of the superficial portion of the liver, and extends thence towards the surface, where it causes the development of a perihepatitis and the formation of inflammatory adhesions between the peritoneal covering of the liver and that of the adjacent organs. These adhesions, when formed, help to localise the abscess to the region of the diseased portion of the liver, and so prevent the occurrence of a general tubercular peritonitis. Any part of the surface of the liver may be affected in this manner, but it has been found that the convex portion of the right lobe is the area which is most commonly involved. When this part is affected, and the abscess attains a considerable size, one variety of subphrenic abscess is established. In those cases in which the inferior aspect of the organ is the seat of the disease, it often happens that a localised chronic abscess is formed, which exists for a long time without giving rise to the appearance of any train of symptoms which render a diagnosis of the nature and situation of the affection possible. Sooner or later an abscess of this kind spreads towards the antero-inferior border of the gland and the neighbouring portion of the posterior aspect of the anterior abdominal wall, and gives rise to the formation of an abdominal swelling, which has the characteristics of a localised abscess. In some cases the inflammatory process may spread to the peritoneum and set up a more or less general tubercular peritonitis, which is accompanied by the manifestation of symptoms which are characteristic of this disease.

*Diagnosis.*—In those cases of tubercular disease of the liver in which an intra-hepatic abscess is formed, it is practically impossible to form a correct diagnosis of the pathological condition of the patient, since an abscess of this kind is not usually associated with any considerable enlargement of the organ, and it does not give rise to a special train of symptoms. The subphrenic variety causes the development of a series of physical signs and symptoms which are similar to those met with in the case of an ordinary subphrenic abscess, which is dependent upon the extension of a tubercular process from the overlying lung or pleura. When the inferior aspect of the organ is the seat of the disease, it is not possible in most cases to diagnose its presence before the inflammatory process has extended to the adjacent portion of the anterior abdominal wall, and a localised abscess has been formed. The tubercular nature of an abscess which is in connection with the liver, can sometimes be discovered by a microscopical examination of the material which is withdrawn from the swelling when it has been explored with the needle of an aspirator or a syringe. If the swelling is due to a tubercular process, the tubercle bacillus may be found in the matter evacuated, but it must not be assumed that if bacilli cannot be demonstrated the disease is not tubercular in origin, since in many cases of old tubercular disease it is not possible to see the bacilli under the microscope on the first examination. The material which is withdrawn by the needle in cases of tuberculosis is usually very thick, and it is necessary to wash out the needle before the contents can be seen and examined.

*Treatment.*—The treatment of a tubercular abscess of the liver does not differ from that which has been recommended in the case of other forms of abscess of the same viscus. In order to promote the easy evacuation of the contents, it will generally be found advisable to scrape the interior of the abscess with a Volkmann's spoon or other similar instrument. After the abscess cavity has been evacuated, its interior should be packed with strips of aseptic gauze which have been impregnated with iodoform emulsion or with iodoform paste, and this method of dressing should be repeated daily. If there are signs of the development of tubercle in other organs, the treatment which is necessary for these affections must also be carried out. The treatment of the subphrenic variety of tubercular abscess will be dealt with in further detail when subphrenic abscess is under consideration. When the affection involves the inferior aspect of the liver and the adjacent portion of the peritoneum, an incision is made over the most prominent part of the swelling, the contents evacuated, and the cavity irrigated and drained.

*Prognosis.*—The prognosis in most cases of tubercular abscess of the liver is not hopeful, since the disease is generally associated with the presence of the tubercular process in other organs, especially in the lungs. When, however, it is localised to the hepatic region, and its presence is diagnosed at an early stage, and appropriate treatment at once adopted, there is a possibility that the disease may be eradicated at least for a time.

# CHAPTER VIII.

## ACTINOMYCOSIS OF THE LIVER.

Actinomycosis of the liver is a chronic infectious disease of a specific nature, which is caused by the presence of a distinct fungus called the "ray fungus" or actinomyces. This micro-organism in animals usually causes the development of chronic inflammatory affections in the lower jaw, or in the anatomical structures which lie adjacent to the buccal cavity; but in man some part of the intestinal or respiratory tract is the situation where the disease most often commences. In a very small number of cases the liver has been the place where the affection has first become apparent. Usually, however, the liver is not the only situation where the disease manifests itself, but this organ only becomes affected in the later stages of the pathological condition, the primary disease being located elsewhere. During the past few years I have seen at least five cases of this nature. In three of these cases the disease was primary in the base of the right lung or the neighbouring portion of the pleura, and spread from this situation through the underlying diaphragm to the adjacent part of the superior aspect of the liver; in the fourth case, the primary seat of the disease appeared to be either in the spleen or possibly in the wall of the alimentary canal, and particles of the growth had been carried from this organ to the liver by the splenic and portal veins; whilst in the fifth case it could not be ascertained in which organ or anatomical structure the affection had originally commenced, on account of the extensive nature of the disease when an examination was made after the death of the patient. From a consideration of these cases, and also those of similar nature which have been published by various observers, it appears to be established that the liver is very liable in man to become affected secondarily in the course of actinomycosis, and this is especially the case when the alimentary canal or the respiratory organs are the primary seats of the affection. The liver is not usually involved in cases of actinomycosis of the skin or of the jaws and the region of the buccal cavity, unless the affection proves to be not amenable to surgical treatment, and the patient dies from a general dissemination of the disease. When the pus from a case of actinomycosis is examined, it is found to contain a number of small, rounded, or somewhat oval-shaped granules, each about the size of a pin's head, and either of a yellowish tinge or even dirty-white in colour. Under the microscope each yellow granule is seen to consist of a closely-woven network of mycelium threads, to the extremities of which small club-shaped bodies may be attached. These bodies are arranged in a radiating manner, and on this account the parasite has been named the "ray fungus." The parasite appears in many of the recorded cases to have obtained an entrance into the human organism with some article of food. If there happens to be an abrasion of the mucous membrane which lines the mouth and buccal cavity, infection may occur through local absorption, and in a similar manner infection may take place from the mucous membrane of the alimentary canal. When the respiratory organs are the seat of the primary affection, it is probable that the infecting agent has been introduced with the inspired air in the form of spores. In those cases in which the liver appears to be the situation of the primary disease, it seems possible that the parasite has been introduced into the alimentary canal along with an article of food, and that it has passed through the walls, either of. the stomach or intestine, into one of the radicles of the portal vein, by which it has been carried to the liver, where its progress has been arrested in the portal capillaries of that organ, and it has commenced to grow. When the liver becomes involved secondarily, it is due either to a direct extension of the chronic infectious inflammatory process, or to the conveyance to the liver of emboli which contain the fungus from a focus of disease in one of the adjacent organs, by the blood vessels or the lymphatics, more commonly by the portal vein.

*Symptoms.*—When the liver is affected primarily, it exhibits the signs and symptoms of a slow and gradual enlargement, characterised by the development of localised swellings which project upon the superficial surface of the organ, and give to it an irregular and bossed outline, which becomes apparent on palpation. These localised enlargements are at first solid, but as the disease progresses they break down and undergo disintegration, and collections of pus are formed which contain the yellow granules mentioned above, each granule having the microscopic structure of actinomyces. The inflammatory process tends to spread to and implicate the surrounding structures at an early stage, and to extend to the surface of the body in the form of a superficial abscess. In one case of this kind which I have seen, the affection became manifest by the formation of a small abscess in the anterior and lower portion of the right side of the chest. The affection in the early stages is slow and insidious, and gives rise to few definite symptoms beyond those of localised swellings. When the affection of the liver is secondary to the development of the primary disease elsewhere, the symptoms which are dependent upon the original disease will assist in determining the nature of the hepatic affection. In one patient upon whom I operated the liver was found to be involved only after the lower part of the chest had been opened in order to drain an empyema which had formed in that region.

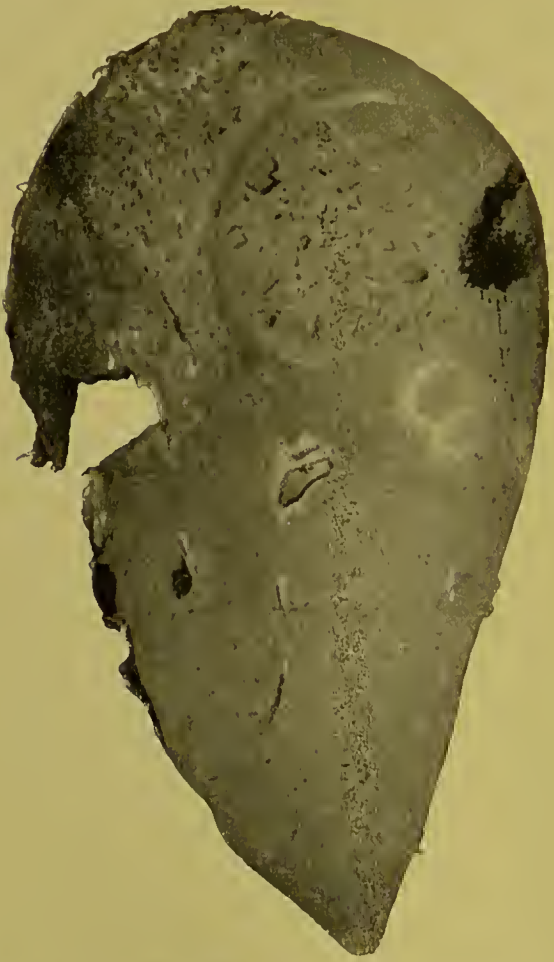

Fig. 16.—Actinomycosis of the Liver. Section of a human liver from a case of actinomycosis. The diseased parts are situated in the upper portion of the specimen, and consist of a coarse meshwork of white fibrous tissue, with a spongy or honeycombed appearance, enclosing spaces of various sizes. The section through the right edge shows the spaces to have coalesced, so as to form an irregular cavity. The diseased tissue has for the most part replaced the normal liver substance.—*St. Barth. Hosp. Museum.*

Recently I have had a second case of this nature, in which the right pleura and the pericardium, together with the right lung, were the seat of an extensive inflammatory affection dependent upon actinomycosis; and on draining the empyema and examining the upper surface of the diaphragm, the disease was felt to extend through this structure into the upper portion of the right lobe of the liver. In most cases of actinomycosis of the liver, the infective process spreads to the adjacent portion of the peritoneum and causes a localised chronic peritonitis, a condition which was met with in the first of the two cases which have been referred to above. When suppuration occurs the temperature of the patient is elevated, but it does not present any definite characteristics in this respect.

*Diagnosis.*—In the early stages of the disease the signs and symptoms resemble those which are due to the development of a slowly-growing malignant tumour, and when these have existed for some time the clinical appearances are those of a chronic abscess. In order to be able to make an absolutely certain diagnosis, it is essential that the characteristic yellow or white granules should be obtained from the swelling, and that these should have the microscopic appearances of the actinomycotic fungus. Naked-eye appearances must not be relied upon, since it is not uncommon for the purulent matter from a tubercular focus to resemble actinomycosis in its superficial and general characters. The pus which is obtained from an actinomycotic abscess is usually very thick and mucoid in nature, and has a peculiar odour.

*Treatment.*—When actinomycosis of the liver has become established, it is difficult to decide which is the best method of treatment to adopt. Some authors have advised the internal administration of large doses of potassium iodide; but in two cases in which I made use of this drug in the treatment of this affection of the liver, I found that it was of no permanent value. The only method of treatment which appears to be likely to be of any great assistance in the destruction of the disease, is the complete removal of the whole of the affected tissues. In those cases in which a diagnosis of the nature of the disease has been made before the granulation tumour has undergone disintegration and gone on to the formation of an abscess, an attempt may be made to remove the diseased tissues in a manner similar to that which is suggested for the treatment of localised malignant tumours. In the majority of cases it will only be possible to make a diagnosis after an abscess has developed, and this has been treated by incision, and the pus evacuated. If an actinomycotic abscess is diagnosed, a free incision is made, the contents of the swelling removed, and if necessary any partitions which may be present between two or more abscesses broken down, so to allow of complete evacuation. The internal wall of the abscess cavity should then be carefully curetted, so as to remove any infected tissue which may be in the liver substance adjacent to the area of the abscess. When this has been done, the cavity which remains is irrigated, and then packed with tampons of iodoform gauze, upon which has been spread a quantity of iodoform paste. This method of dressing should be carried out at first daily and later every other day. In many cases it is found to be impossible to remove the whole of the infected tissues, on account of the extensive nature of the disease. It is advisable, in addition to the local treatment of the disease, to give potassium iodide internally, commencing with small doses, and increasing them to about 30 grs. three times a day.

*Prognosis.*—The outlook in every case of actinomycosis of the liver is extremely serious. All the cases of this kind which I have seen have terminated fatally. In some cases it may be possible to remove the primary focus of the disease, and drain the abscesses in the liver, but in most cases the connections of the diseased tissues are so extensive that surgery is unable to effect its total extirpation, and it does not seem possible to depend upon any medical measures alone for its relief. The prognosis of actinomycosis of the skin or of the jaws and mouth is in most cases very favourable, but when the internal viscera, especially the liver are involved, it is the reverse.

# CHAPTER IX.

## SYPHILIS OF THE LIVER.

Affections of the liver are met with in both the secondary and tertiary stages of acquired syphilis, and also as manifestations of the congenital form. When the extreme frequency of acquired syphilis is taken into consideration, the liver appears to be only rarely attacked, but if we make a comparison between the occurrence of syphilitic affections of the liver and of the remaining abdominal viscera (the rectum being excepted), we shall find that this is the organ which is most commonly the seat of the disease. In congenital cases, it is found that the liver is one of the organs which is most frequently affected.

*Secondary affections.*—During the secondary stages of syphilis, at the period when the cutaneous eruptions are manifest, the individual affected is liable to become jaundiced. The jaundice comes on somewhat gradually, lasts for a short time, usually not more than from one to three weeks, and then disappears. This condition is supposed by some authorities to be caused by the development of an interstitial infiltration of the hepatic tissue, which presses upon the commencement of the small bile ducts so as to obstruct the flow of bile along them, and thus induce the occurrence of an attack of jaundice. Other observers think that there is a catarrhal condition, followed by swelling of the mucous membrane lining the bile ducts, diminution in size of their lumen, and consequently biliary obstruction and jaundice. In all probability the latter hypothesis is correct. In one case which I have had under my own observation, an attack of jaundice developed during the eruptive stage of secondary syphilis, and was accompanied by a distinct fluid enlargement of the gall bladder, this viscus projecting as a smooth oval tumour below the costal margin half-way towards the umbilicus. Mercurial treatment was adopted, and after about ten days the jaundice and enlargement of the gall bladder simultaneously disappeared. The jaundice had developed in this patient about two weeks after the appearance of the cutaneous eruption.

*Treatment.*—The usual anti-syphilitic remedies should be administered, most reliance being placed upon the preparations of mercury, and the bowels kept freely moved. In the majority of cases the jaundice will disappear and the liver resume its normal condition.

*Tertiary affections.*—Under this heading are included those pathological affections of the liver which are met with in patients suffering from congenital syphilis, and also in those who are the subjects of tertiary syphilis. In all cases the condition is one of chronic inflammation, and this may be either diffuse, affecting the whole gland, or it may be localised to one or more definite spots. Thus there may be distinguished two classes, the first of which we shall call "diffuse syphilitic hepatitis," and the second "localised syphilitic hepatitis." The two classes will be discussed separately.

*Diffuse syphilitic hepatitis.*—This affection is met with much more frequently in children who are the subjects of hereditary syphilis, than in older people who are suffering from acquired syphilis. In fact adults are very rarely the subjects of this affection. The disease is characterised by a general infiltration of the liver with small cells, which at first occupy the space in the neighbourhood of the intra-hepatic blood vessels and bile ducts, and later extend into the glandular acini. These small cells are apparently derived from a proliferation of the connective tissue cells which are found in the prolongations of Glisson's capsule within the liver. When the growth of small cells has extended into the acini, the groups of hepatic cells become flattened and pressed upon, and they may exhibit signs of fatty or granular degeneration. The liver itself in these cases is considerably enlarged, especially in the earlier stages, and on section it usually presents a greyish or greyish-red appearance. In the later stages, the small-celled growth tends to form fibrous tissue, which undergoes contraction, and then the bulk of the gland will be diminished, and its surface become nodular or irregular. Some cases of cirrhosis of the liver in young children have been said to be the later stages of a diffuse syphilitic hepatitis, in which the fibrous tissue has gone on to the stage of contraction. There is, however, very great difficulty in making an exact and correct diagnosis in these cases. Several cases have been recorded in which the liver has been the seat of a chronic induration, involving the whole gland, and accompanied by a small amount of nodosity on the surface. As we have already seen, the majority of cases of this variety of disease are to be found in children who are the subjects of congenital syphilis. Occasionally, however, patients of mature age have been found to be affected, and in these cases acquired syphilis has been present. Still-born children, the offspring of syphilitic parents, are often found to have their livers in a state of induration and enlargement, owing to this form of hepatitis having been established.

Between the form of diffuse syphilitic hepatitis and the localised variety there are a considerable number of gradations, one form of the disease running insensibly into the other. In these cases, in addition to the interstitial inflammation, there are present numerous small tubercles, which have the structure of a minute gumma or granulomata.

*Localised syphilitic hepatitis.*—This is the commonest variety of disease of the liver in connection with syphilis. It is usually met with in the tertiary stage of acquired syphilis, but less frequently it is found in children or young adults as a manifestation of the hereditary form. The inflammatory process may involve one or more localised portions of the hepatic substance, and give rise to the development of definite tumours, which are usually situated near the surface of the gland, although less commonly they are embedded in its substance, and are not apparent upon the surface. The anterior and superior surfaces of the liver are more frequently the seat of these tumours than the inferior. The tumour may be single or multiple; when single it consists of a large, somewhat irregularly-shaped mass of fibrous tissue or small-celled growth, which is circumscribed, but may have processes passing into the neighbouring hepatic tissue; or it may have the form of a roundish mass, consisting, as regards its central portion, of caseating material, and enclosed externally by a definite fibrous capsule. When multiple, the individual tumours or gummata may be entirely separate and distinct, or may at certain points run into one another. Occasionally a gummatous tumour, situated at the margin of the liver, becomes pedunculated. When these tumours involve the surface of the liver, they usually give rise to the development of localised perihepatitis, which causes the gland to become adherent to the adjacent anatomical structures, especially the lower surface of the diaphragm, less commonly the stomach and transverse colon, and, in rare cases, other of the abdominal viscera. When this variety of tumour has existed for some time, in the majority of cases the fibrous tissue or small-celled growth of which the swelling is composed, undergoes contraction and causes the formation of depressed scars or cicatrices.

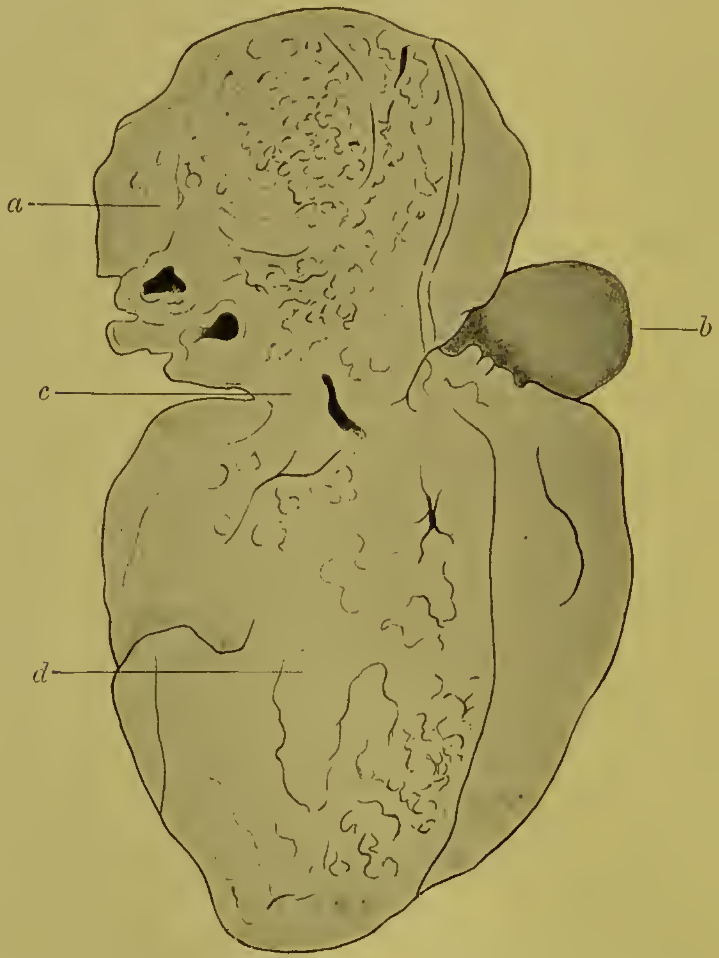

Fig. 17.—The liver of a girl who was the subject of congenital syphilis. The right lobe is divided into two superimposed halves, the lower being the larger, by a ring of dense cicatricial tissue, which is the remains of old gummata. The left lobe is only represented by a small fibrous mass. *a*, upper half of right lobe; *b*, left lobe; *c*, ring of cicatricial tissue; *d*, lower half of right lobe.

By this means the surface of the organ may become very irregular, and present a nodulated appearance, whilst the volume of the gland is diminished. The remaining uninvolved hepatic cells are, however, said to undergo a compensatory hypertrophy. The deformities which are produced in this manner are very various.

The left lobe has often been found to be represented by a shrivelled-up nodule of hard, dense, fibrous tissue. In one case which I saw in St. Bartholomew's Hospital, the right lobe was completely divided into two superimposed halves, and the left lobe had almost disappeared. Fig. 17 represents the liver of this case in vertical section. The patient was a girl, æt. 20, who was the subject of congenital syphilis. The tumour may occasionally press upon and obstruct the hepatic or portal vein, the hepatic artery, or one of the large bile ducts, or the cicatrix which results may involve these same structures. In both cases, ascites or jaundice may be produced. Dr. Fagge mentions a case occurring in Guy's Hospital in which the hepatic vein, close to its junction with the vena cava inferior, was pressed upon in this way, and ascites produced. In one patient whom I have had under observation, a perihepatitis of syphilitic origin caused pressure upon the portal vein in the portal fissure, and consequent ascites. The exciting cause of the development of gummatous tumours in the liver is unknown. It has been suggested that injuries in the hepatic region in patients who have suffered from syphilis may be the exciting cause in a certain number of cases. In nearly all cases of gummata of the liver, caseation and formation of fibrous tissue take place; in very rare instances, however, the tumour, instead of undergoing this change, may break down and liquefy, and there is produced a fluid swelling, generally filled with a yellow liquid in which are numerous flakes.

*Symptoms.*—Tertiary syphilitic disease of the liver in many patients gives rise to the production of few symptoms. Often its existence only becomes apparent when a post-mortem examination is made after the death of the patient from some other affection. When definite symptoms are present they are due to changes in the size and shape of the viscus, to obstruction of the portal vein or the bile ducts, or to perihepatitis. If there are numerous gummatous tumours in the liver, they alter the shape and size of the gland, so that irregular nodular swellings can be felt upon its surface, which are usually painless to pressure from without. The liver may attain a considerable size as a result of the development of these tumours, and then it resembles in many respects a liver which has been enlarged owing to the formation of numerous primary or secondary malignant growths. The rate of increase in size of the organ is, however, much slower in syphilitic affections than is the case in malignant disease, whilst there is not the same marked wasting and cachexia. Ascites or jaundice may be well-marked symptoms, resulting from pressure upon or involvement of the structures surrounding the portal vein or the bile ducts in the portal fissure. In the later stages of the affection contraction takes place, and a condition may arise which may be called syphilitic cirrhosis. This is much more common in children, although it has been observed in adults, and usually follows the interstitial form. The localised variety is succeeded by scarring or the formation of irregular deformities, which have been already mentioned. If the deformities so produced are considerable, they may become apparent as definite tumours which occupy the upper portion of the abdominal cavity; in all cases they move with the respiratory movements and are fixed above to the liver. In some cases of this kind diagnosis is very difficult or almost impossible. In the case which was mentioned above, where the liver had been divided into two superimposed halves, the left lobe being represented by only a small amount of hard fibrous tissue, the lower portion projected as a large tumour downwards below the umbilicus, and was apparently attached to the inferior part of the right lobe. When the liver is generally enlarged, there may, in some cases, be a feeling of fulness or heaviness in the right hypochondriac region; in others, pain is the predominant symptom, and this may be slight or severe. It may be localised to definite spots or it may involve the entire hepatic region. The pain may be constant and last for several weeks or even months, or it may only come on at intervals. Symptoms of perihepatitis with localised pains may occur in any case of localised syphilitic hepatitis. Pain in the region of the right shoulder or the lower end of the scapula does not appear to be very often present in cases of syphilitic perihepatitis. In some cases a friction rub can be felt and heard over the upper portion of the hepatic area. This is said to be due to friction between the upper surface of the liver and the lower surface of the diaphragm during the movements of respiration. It is only met with in perihepatitis.

Lancereaux says that the tumours on the surface of the liver in tertiary syphilis are more circumscribed and harder in consistency than the swellings which are formed in malignant disease. This distinction appears to be too slight to be of any value, since it is often impossible to make out such differences, especially when the patient is not emaciated. Slight bronzing of the skin has been said by Lancereaux to be often present in cases of syphilitic disease of the liver. This, however, does not appear to be constant, but when it is present it will help in making a correct diagnosis.

Enlargement of the spleen, owing to the presence of gummatous growths or to amyloid disease, accompanies a similar condition of the liver, whilst in malignant affections it is very infrequent.

In congenital cases the liver often projects a variable distance below the costal margin, as far as the umbilicus, or even lower, and it then forms a smooth hard swelling with a definite inferior margin.

*Diagnosis.*—The history of heredity as regards syphilis, or symptoms of previous syphilitic affections, such as scars on the legs, external genital organs, or about the mouth and pharynx, help very considerably in forming a correct diagnosis. The absence of well-defined symptoms, the slow rate of growth of the tumour, and the non-existence of marked cachexia and wasting, are of great importance and value in establishing a diagnosis and in distinguishing the affection from a case of malignant disease. The advanced stages of syphilitic cirrhosis of the liver are difficult to distinguish from malignant disease, especially when old people are affected and when there is much nodulation and general marasmus. It is said by some authorities that malignant disease is more commonly localised to either the right or left lobe of the liver, at least in the early stages, whilst in syphilis both lobes are usually involved. This fact is not of much value in establishing the diagnosis, since it is very difficult and often impossible to make out whether one or both lobes of the liver are affected with the disease. In some cases the age of the patient is of importance, as quite one-half of the cases of syphilitic disease of the liver occur in people who are under forty, and cancer of the liver usually occurs in patients who are considerably over this age. The presence of an enlarged spleen is in favour of syphilis, since it is common in this affection and rare in cancer.

*Treatment.*—The usual anti-syphilitic remedies are the most useful in combating the affection. Potassium iodide is the most valuable, and should be administered in gradually increasing doses. If there is much anæmia, iodide of iron will be found more serviceable. It should be given in doses of half a drachm twice or thrice daily. Good climatic and hygienic conditions should be insisted upon as adjuvants to the drugs. A sea-voyage or residence at a seaside resort will often prove beneficial. There are a few cases on record in which gummatous tumours of the liver have been diagnosed as malignant disease, and have been excised and the patients have recovered. In doubtful cases a course of potassium iodide should be tried before any operative measures are adopted. Preparations of mercury have, in some cases, been followed by improvement. Usually, however, potassium iodide will be of more value.

*Prognosis.*—The prognosis is moderately good in many cases, but when syphilitic cirrhosis is well established, and is accompanied by general marasmus, a fatal issue usually occurs at an early date. Some cases which are apparently hopeless, improve, however, under the influence of drugs and good nursing. Many cases improve for a time, or even apparently recover, and at a later date are followed by a relapse which is ultimately fatal. A certain number of patients recover and die from other diseases. In children the prognosis is much worse than in patients who suffer from acquired syphilis. They usually die during the first few months of life. In adults the disease may go on for several years before it ends fatally.

*Amyloid disease of the liver.*—Amyloid disease of the liver may occur during the course of tertiary syphilis. The whole gland is involved and becomes generally enlarged. It is very hard and smooth, often projecting for some distance below the margin of the ribs. It is accompanied by symptoms of amyloid disease in other organs, such as the kidneys and the intestines. The treatment is the same as for tertiary syphilis.

# CHAPTER X.

## HYDATID CYSTS OF THE LIVER.

Hydatid or echinococcus cysts are the larval forms of a tapeworm, which is called *Tænia echinococcus.* The adult worm has its habitat in the alimentary canal, usually the small intestine, of various animals, and it has been most commonly found infesting the domestic dog, the wolf, and the jackal. Each worm is small, and does not measure more than 5 mm. in length. It is divided by transverse constrictions into three or four segments, the anterior, which is the smallest, being the head. The head is armed with four suckers, two rows of hooklets, each row having from twenty to forty, and a rostellum. The two middle segments are small and immature. The fourth or terminal segment of the parasite is sexually mature, and in this segment the ova are formed, and then shed into the lumen of the alimentary canal of the host, whence they are voided per anum along with the excreta. The ova generally reach the alimentary canal of man by becoming mixed with, or adherent to, some substance which is used as an article of food. They are often taken along with drinking water, or with some vegetable which is eaten as a salad, such as watercress. Human beings who are of uncleanly habits, and who, by their occupation, come into intimate contact with dogs, are liable to contaminate their food with ova, and become infected in this manner. When an ovum has gained an entrance into the alimentary canal of man, the external coat of the parasitic egg is dissolved by the chemical action of the gastric juice, the outer surface of the egg gives way, and a small embryo with six hooklets is set free. This embryo makes its way through the tissues which form the walls of the alimentary canal, and may then pass in different directions. In the majority of instances it bores its way into one of the radicles of the portal vein, by the blood stream of which it is conveyed to the liver, where its onward course is arrested in one of the portal capillaries. The early stages of development are gone through after the ovum has been arrested in the liver. According to Leuckart,[1] in the earlier stages the embryos have the appearance of small, white, rounded spots, the outer portion of which consists of a layer of thick transparent material, and forms the external wall of a small capsule or cyst. This wall shows signs of concentric lamellation, and the interior of the cyst is occupied by material which has a coarsely granular appearance. The cyst gradually increases in size, and at the end of four or five months it has attained a diameter of 5 mm., and minute echinococcus heads begin to develop upon the internal aspect of the cyst wall as small buds. Each bud represents the head and neck of a mature tænia echinococcus, and has four suckers and a small rostellum, which is provided with hooklets. Each head is contained within a brood capsule, and the rostellum, with its suckers and hooklets, can be protruded and withdrawn. The brood capsules are continuous with one another by means of the parenchyma which forms the wall of the cyst. If the heads or scolices become detached from the wall of the cyst, they very soon lose their vitality and die (Leuckart). The brood capsules occur in groups or bunches, and each capsule, with its contained heads or scolices, measures about 1·5 mm. in diameter. The brood capsules may, however, increase in calibre, and have a diameter of 1 or 2 cm., and then they form daughter cysts upon their internal surface, which daughter cysts may in their turn form on their internal surface so-called grand-daughter cysts.

*Structure of an adult hydatid cyst.*—The external wall is made up of two separate and distinct layers—an external one, which consists partially of chitin, is elastic, and has a marked tendency to curl up when it has been divided; and an inner or parenchymatous layer, which consists of a granular basis material, in which are calcareous particles especially between the attachment of the scolices, a certain number of cells, and a few unstriped muscular fibres. The brood capsules, which contain the scolices, are derived from the parenchymatous layer. The structure of the wall of a brood capsule differs somewhat from that of a parent cyst. The wall consists of two layers, each of which has a definite structure, the external layer being of the nature of parenchyma, and the inner cuticular, a condition which is the reverse of that which obtains in the wall of the parent cyst. When crops of brood capsules are produced the parent cyst increases in size, but it is possible for a cyst which forms no brood capsules, to attain a considerable size. Leuckart says that scolices are produced from the external wall of the capsule, and that when fully developed they become invaginated, so that the original internal cuticular surface of the scolex becomes external. The presence of a hydatid cyst in the liver acts, to a certain extent, as an irritant to the adjacent portion of the hepatic tissue, causes increased vascularity, and gives rise to the formation of a considerable amount of fibrous tissue, which appears as a secondary capsule or covering to the parasite. In the majority of cases in which hydatid cysts form in the liver of man, it is found that the cyst is single, although occasionally several may be present, but in cattle it is not at all uncommon for hydatid cysts of the liver to be multiple.

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[1] Leuckart "The Parasites of Man," 1886 (Eng. trans.).

It is not necessary that a hydatid cyst should pass through all the stages in development which have been described. In some cases it happens that no scolices or daughter cysts are produced, and then the cysts are known as sterile hydatids or acephalocysts. Acephalocyst hydatids may, however, attain a considerable size owing to the extensive growth of a single cyst. It has been observed in rare cases that a hydatid cyst, instead of producing daughter cysts on its internal aspect, has formed buds upon its external surface, which penetrate between the tissues of the organ in which the hydatid is situated, and also extend into other anatomical structures in the neighbourhood. Fagge[1] relates a case of this kind which occurred in Guy's Hospital under Dr. Rees.

*Frequency.*—Hydatid disease is much more frequent in some countries than in others. In London it is not uncommonly met with, but in the provinces and in Scotland it is said to be much less common. This fact is said to be associated with the circumstance that London dogs are far more frequently infested with the tænia echinococcus than those living in other parts of the United Kingdom. The affection is very common in Australia; and in Iceland it is one of the chief etiological factors in the mortality rate. In France and Germany the affection is met with, but is not common, and in Russia it is very rare.

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[1] Fagge, "Text-Book of Medicine," 3rd edition, vol. ii.

*Situation.*—Hydatid cysts, when affecting the liver and biliary system, may be met with in connection with the liver, gall bladder, biliary ducts, or in the hepatic region; and when they are located in the hepatic region they may occupy the subphrenic space, or they may lie between the liver and one of the adjacent abdominal organs. When they are situated in the liver they may be entirely hepatic; that is to say, they do not appear on the surface, but remain within the substance of the organ, or they may protrude upon any of the surfaces of the gland, the superior, anterior, and inferior portions being most commonly involved in this manner.

*Symptoms.*—Hydatid disease of the liver may exist for a long time without giving rise to any definite train of symptoms from which its presence may be suspected, and in many cases cysts have been discovered post-mortem, the existence of which had not been thought of during life. Usually the first symptoms to be noticed are either the presence of a localised tumour or swelling within the hepatic area, or some form or variety of pressure symptom. This is due to one or other of the neighbouring viscera being pressed upon by the cyst. The tumour, when it is first discovered, may be only the size of an orange, but as the growth of the parasite proceeds it may occupy the greater portion of the abdominal cavity, and even extend as far downwards as the pelvis. The direction of extension of the parasitic cyst varies according to its primary position. If it is situated at first upon the superior surface of the liver, it will extend upwards and encroach upon the pleural cavity, especially the right, at the same time pushing upwards the diaphragm; whilst in most of these cases the liver will be pushed downwards, so that its inferior border can be felt a variable distance below the costal margin. When the cyst is situated upon the anterior surface, it tends to grow forwards and downwards, producing a smooth elastic tumour, which is more or less globular in shape, and can be easily felt by palpation through the anterior abdominal wall. If the cyst is multiple the surface will have a lobulated or bossed outline. Since a hydatid cyst is filled with fluid, it often happens that on palpation fluctuation can be detected. This, however, is not invariably the case, as, owing to the tenseness of the cyst, it can often only be distinguished as an elastic tumour. Many authors have described a peculiar thrill of vibration which they call "hydatid fremitus," as being obtainable in tense hydatid cysts. It is obtained by placing three fingers of the left hand upon the most prominent portion of the tumour, and then tapping the middle of these three fingers with the index finger of the right hand, when a distinct thrill is communicated to the other two fingers. This sign is not always obtainable in hydatid cysts, and when it is present it is not an infallible test of the presence of a hydatid cyst, since it can be obtained occasionally in tense cysts which are not hydatid in character. As the tumour increases in size, pressure symptoms appear, and these are of different kinds, owing to the fact that various structures may become compressed and have their normal physiological functions disturbed. Difficulty in breathing is caused by extension of the tumour upwards, and compression of the lungs or bronchi. When hydatid tumours attain a very large size, these disturbances in the respiratory function may be very distressing. Pressure upon the stomach or intestinal canal causes abdominal pain, vomiting, dyspepsia, constipation, and occasionally attacks of diarrhœa, which may alternate with periods of constipation. The inferior vena cava or the portal vein may be pressed against the posterior abdominal wall, so that the blood stream is impeded through the blood vessel involved. When this occurs, œdema of the lower extremities, ascites, and hæmorrhoids become marked symptoms. These symptoms, however, are not very common as the result of hydatid cysts of the liver. In some cases it happens that the peritoneum which overlies the tumour becomes inflamed, either as the result of pressure or a local injury, and localised pain and tenderness are then noticed. Jaundice is rarely seen in this class of disease, and when present is due to direct pressure by the cyst upon some portion of the biliary ducts, resulting in obstruction to the free flow of bile; or in the establishment of a catarrhal condition of the mucous membrane lining the affected ducts which causes secondary obstruction; or the cyst may rupture into one of the large bile ducts, and the daughter cysts pass into the lumen of the biliary canal, where they become impacted, and produce a mechanical obstruction, which is followed by the development of jaundice. When a hydatid cyst ruptures, and its contents are discharged into the bile ducts, attacks of colic may either coexist with or may precede the attack of jaundice.

*Rupture of a hydatid cyst.*—A hydatid cyst of the liver may undergo spontaneous rupture, and its contents pass into one or other of the surrounding viscera or serous spaces. The rupture may be induced by the accidental application of a slight local violence, or it may occur quite independently of any such event. When the cyst bursts into the stomach or some other part of the alimentary canal, its external surface usually becomes adherent to the hollow viscus by a process of adhesive inflammation, which is followed by a giving way of the tissues which compose the septum between the cavity of the alimentary canal and that of the cyst. When the rupture takes place into the stomach, the daughter cysts may be either vomited or passed per anum; but if the contents pass into the intestine beyond the stomach, they are in all cases evacuated per anum. Rupture of a hydatid cyst into some portion of the alimentary canal is a favourable method of termination, since in the majority of instances it is followed by a spontaneous cure. Rupture may take place into the peritoneal cavity, and when this occurs it is usually accompanied by the development of severe symptoms of shock and collapse, which may prove rapidly fatal unless radical surgical measures are promptly adopted. As a result of rupture into the peritoneal cavity, the patient may develop an urticarial rash, due to the absorption into the circulatory system from the peritoneum of some of the chemical constituents of the contents of the cyst. The substance which is the cause of the urticarial rash is probably of the nature of a ptomaine or toxine, but its presence in the fluid of hydatid cysts has not been established in every case. Brieger has separated such a substance, which may possibly be the body in question. Rupture into the right, or rarely the left, pleural cavity occurs; or, if the pleural cavity has been obliterated by adhesions, the contents of the cyst may pass into the substance of the lung. When rupture into these viscera occurs, pleurisy or pneumonia or both may result, and occasionally the daughter cysts or their membranes may be coughed up after having previously passed into one of the bronchi. The pericardium may also be the seat of the rupture, and then a fatal termination quickly follows in nearly every case. Occasionally the external surface of the cyst becomes adherent to the posterior aspect of the anterior abdominal wall, and then as a result of inflammatory processes or local injury the cyst ruptures externally and its contents are discharged. Rupture may also take place into the gall bladder or the lumen of one of the larger biliary ducts. This is accompanied by signs of biliary colic, which is due to the passage of small cysts or portions of cyst membrane along the bile duct to the duodenum. In the Museum of St. Bartholomew's Hospital there is a specimen which was obtained from the body of a boy, æt. 14, who three months previous to his death had signs of acute inflammation of the liver, and six days before death had acute pain in the right hypochondrium, followed by jaundice (Fig. 18). He was relieved for a time, but the symptoms recurred with greater severity, and he died delirious. On examination after death, the common bile duct was found to be the seat of a large rolled-up hydatid cyst, part of which protruded into the duodenum through the opening of the common bile duct. In

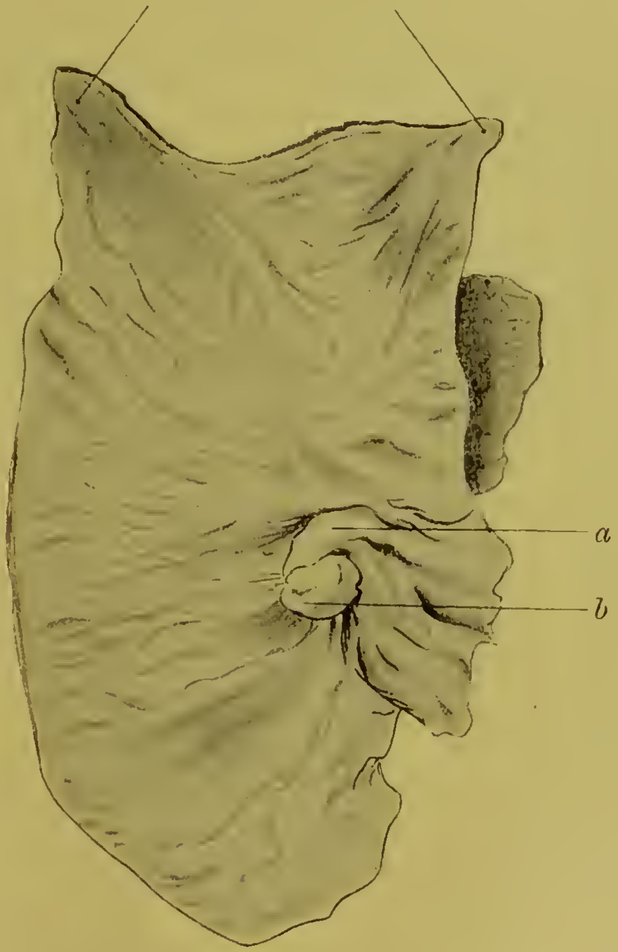

FIG. 18.—Portion of a duodenum with a large hydatid, rolled up and impacted in the common bile duct, which it dilates, and from which a portion of it protrudes into the lumen of the intestine. *a*, biliary papilla; *b*, rolled up hydatid cyst.—*St. Barth. Hosp. Museum.*

the right lobe of the liver there was a large cyst filled with hydatids. As a result of rupture into the biliary passages, cholecystitis, or an inflammatory condition of the bile ducts, may be induced and give rise to jaundice, or, as mentioned above, the jaundice may be due to the impaction of a cyst in the common duct. If the daughter cyst, or a portion of membrane, remain within the cavity of the gall bladder, it may act as the exciting cause of the development of a gall stone, owing to the deposit upon its surface of some of the solid constituents of the bile. Cases have been recorded in which hydatid cysts have burst into some part of the urinary system, usually into the bladder or the pelvis of the kidney. Jonassen[1] mentions a case of this kind where the cyst became impacted in the urethra, and it was necessary to open this canal in the perineum in order to extract the cyst membranes. In a few cases a hydatid cyst has become adherent to the inferior vena cava, and this has been followed by a rupture of the cyst wall and the wall of the blood vessel, and then the contents of the parasitic cyst have passed into the blood stream. The smaller daughter cysts and portions of the membranes of the larger ones have in these cases been carried to the pulmonary artery, where they have become arrested and caused embolism which rapidly proved fatal. Rupture of the cyst may also occur into the portal vein as it lies in the neighbourhood of the transverse fissure of the liver. In many cases which have been recorded in surgical literature, it has been found that a hydatid cyst has ruptured and formed communications simultaneously with more than one serous sac or hollow viscus. Thus Cayla mentions a case where a cyst communicated with the bile duct and the right pleura, and Bulau records a similar case. Guterboch also records a case in which the cyst lay between the liver and diaphragm, and communicated with the pleura and the intestine. Communications between a hydatid cyst and the gall bladder and the duodenum, and with the intestine and the pelvis of the kidney, have been met with.

*Suppuration.*—In certain cases of hydatid cyst of the liver, after the tumour has existed for some time suppuration is established, and is associated with the signs and symptoms of a hepatic abscess. This suppurative process may be due to the application of a localised mechanical force to the region of the cyst in the liver, or it may be dependent upon the conveyance of a septic embolus, from a focus of suppuration in some other part of the body, to the parasitic cyst. Small boils of the skin, and similar small local suppurations, have been met with in

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[1] Jonassen, quoted by Langenbuch.

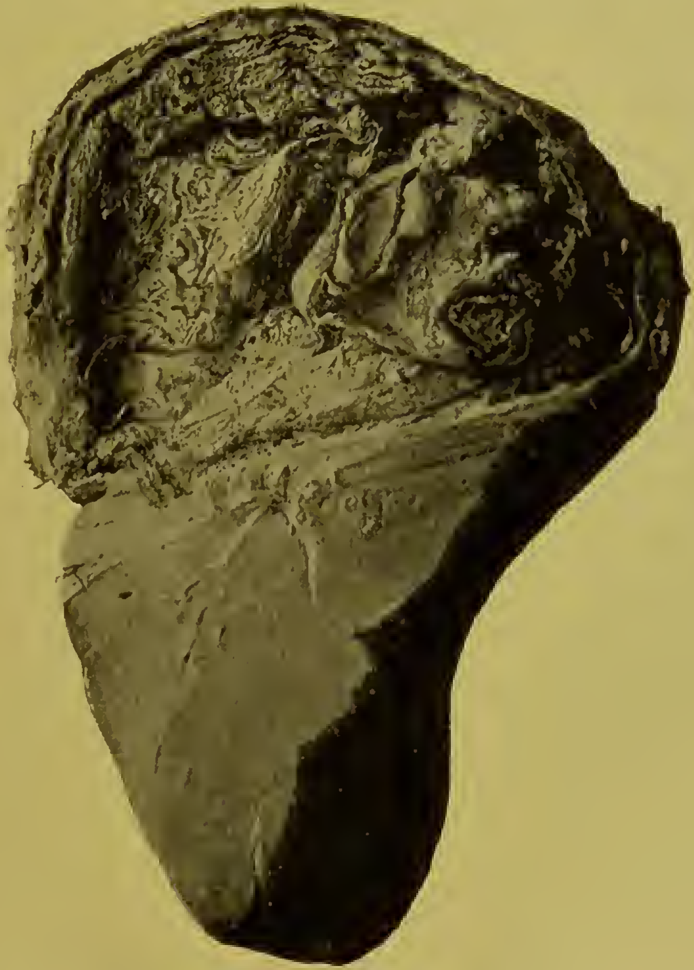

FIG. 19.—Hydatid cyst of the liver.—Part of a liver, with half of a large hydatid cyst which occupied the superior surface of the right lobe. Its wall is tough, and in places has degenerated into a calcareous mass. The interior of the cyst is occupied by the remains of many hydatids, whose walls, contracted and shrivelled, are recognised by the tortuous lines and fissures seen on the surface of the section. The remaining contents of the original cyst, as well as those of the contained daughter cysts, are converted into a pultaceous substance, filling the interstices between the remains of the cyst wall.—*St. Barth. Hosp. Museum.*

association with the occurrence of suppuration in old hydatid cysts, and have been supposed to be the focus from which the suppurative micro-organisms have been derived. In other cases the suppuration appears to be dependent upon a pyæmic process, the cause of which is not apparent. Whenever suppuration in a hydatid cyst of the liver occurs, the symptoms and physical signs resemble those of an abscess of the liver, usually preceded by symptoms of hepatitis. A hydatid cyst of the liver may exist for many years before it undergoes suppuration.

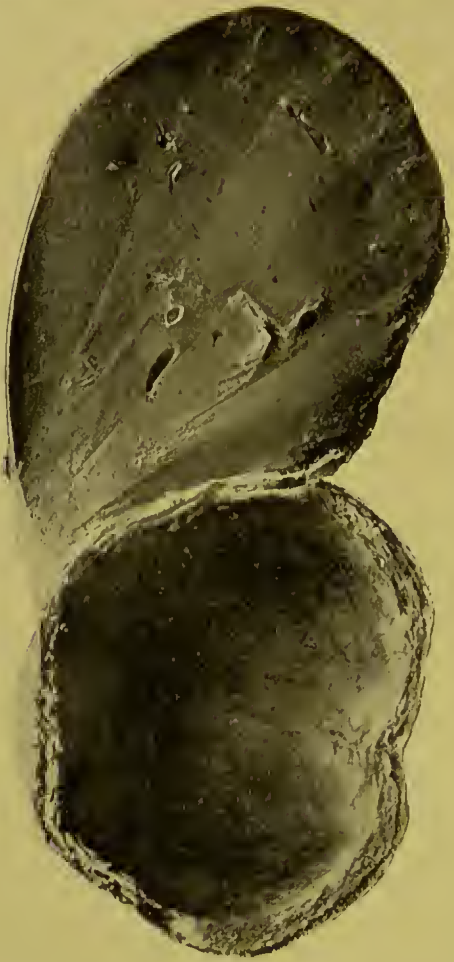

FIG. 20.—Calcareous degeneration of a cyst wall. Section through a portion of a liver with a large cyst, probably hydatid in nature, the walls of which are calcified. The liver was normal in size and texture, and from the antero-inferior margin of the right lobe, just to the right of the gall bladder, a tumour projected, in size equal to a cricket ball, of stony consistence, and calcified. It was intimately adherent to the duodenum and colon, and slightly to the right kidney. On sawing through the tumour, it was found to contain bile-stained fluid and a few pultaceous masses, from which all trace of structure had disappeared. The tumour gave rise to no symptoms during life, and the patient died from an intercurrent disease. —*St. Barth. Hosp. Museum.*

*Spontaneous cure.*—Some hydatid cysts of the liver, especially those which have a tendency to remain small, may cease to grow, and finally die and undergo a spontaneous cure. After the death of the parasite the fluid portion of the tumour is absorbed, until the only remnant of the original swelling is a focus of caseous white material, which has been compared to a mass of wet mortar (Fig. 19). The cyst wall in these cases becomes thickened or cartilaginous, or even calcareous (Fig. 20), whilst the vesicles shrivel up and burst. The colour of the mortar-like contents of the dead cysts varies ; usually it is white, but it may be of a yellowish tinge. When the mortary contents of the dead cyst are examined under the microscope, they are found to consist of fat cells, cholesterin crystals, remains of hooklets, and débris containing numerous calcareous particles. After a cyst has undergone the so-called spontaneous cure, suppuration may occur, and an abscess of the liver result. There is a specimen of this kind in the Museum of St. Bartholomew's Hospital.

*Entrance of bile into the cyst.*—Occasionally, as the result of pressure, or on account of an extension of an inflammatory process, a hydatid cyst of the liver may communicate with the lumen of one of the bile ducts, or with the cavity of the gall bladder, and bile may pass into the interior of the tumour. When this occurs the parasite is killed by the action of the bile, and then the cyst either shrivels up and undergoes a spontaneous cure, or a process of suppuration is induced, which is followed by the development of a hepatic abscess. This is the more usual result of the entrance of bile into a hydatid cyst, but in rare cases the parasite may survive.

*Hæmorrhage from the sac.*—Rupture of a cyst may be followed by a hæmorrhage from the blood vessels which lie in the adjacent tissues, and this may be so severe as to lead to a fatal termination. A case has been recorded in which hæmorrhage from the surrounding tissues took place into the bed of the tumour. This was the result of an injury, and the patient died from the shock.

*Composition of the fluid of a hydatid cyst.*—The fluid which collects within the interior of a hydatid cyst is neutral in reaction, colourless or very slightly opalescent in appearance, and it has a specific gravity which varies between 1006 and 1016. From the analyses which have been made by Hayem, Munk, and Heintz, the proportion of the water varies between 97·8 per cent. and 98·7 per cent., and the amount of solids between 1·3 per cent. to 2·2 per cent. The solids consist partly of inorganic salts, chiefly sodium chloride and phosphates, sulphates, and carbonates, whilst the organic substances consist of traces of proteid material and a small quantity of extractives. Brieger and Mourson and Schlagdenhauffen have separated a poisonous ptomaine from the fluid, and this body may be the cause of the urticarial eruptions which are observed in many cases of rupture of the cyst associated with the entrance of the fluid into a serous cavity, from which it is absorbed into the general circulation. Small quantities of sugar, urea, and kreatin have also been obtained. When the fluid is examined with the microscope, it is often seen to contain a number of hooklets, and occasionally shreds of cyst membrane.

*Diagnosis and differential diagnosis.*—The diagnosis of the presence of a hydatid cyst in the liver is often somewhat difficult, owing to the indefinite character of the symptoms. The existence of a slowly-growing swelling, situated in the hepatic region and connected with the liver, which on palpation is found to be elastic, or to present the signs of fluid, and which gives rise to few symptoms, will suggest the possibility of the presence of a hydatid cyst. A tumour which is due to the presence of a hydatid cyst in the liver is usually single, but in very rare cases it is multiple, and in the other case the surface of the liver is found to be bossed and irregular in outline. It is attached to some portion of the liver, or is embedded in its substance and participates in the hepatic movements due to respiration. In doubtful cases it may be justifiable to puncture the swelling with the needle of an aspirator, and withdraw a small quantity of the fluid contents of the swelling. In case the fluid which is evacuated in this manner should happen to be purulent, it is advisable to be prepared to proceed further and evacuate the contents of the swelling by one of the methods which are described in the treatment of hepatic abscess. If the fluid which is withdrawn is found to contain hooklets and fragments of cyst wall, the diagnosis of hydatid cyst will be confirmed.

Hydatid cysts of the liver, hepatic region, or biliary system, may be confounded with or mistaken for a considerable number of distinct pathological conditions, the most important of which are the following, namely:—

(*a*) *Localised solid enlargements of the liver.*—These enlargements are usually due to the presence of secondary foci of malignant disease, the primary growth being found elsewhere, or to localised gummata which are the manifestations of tertiary syphilis. On palpation, tumours of this nature are found to be solid, but if there is any difficulty in making a thorough examination of the liver and the adjacent portion of the abdomen, chloroform should be administered, and the examination made when the patient is anæsthetised. If a sarcomatous or carcinomatous growth is met with in any other part of the body, especially in connection with the alimentary canal, it will point to the fact that the enlargement of the liver is in all probability due to deposit of the disease there. The past history of the patient as regards a previous attack of syphilis may serve as an indication in making a diagnosis, but the history alone must not be implicitly relied upon. If necessary, the swelling may be explored with the needle of an aspirator.

(*b*) *Simple cysts of the liver.*—These cysts are very rare, and when present are usually serous in nature. It is extremely difficult to make a correct diagnosis in these cases, but their existence may be suspected if the fluid which is withdrawn through the needle of the aspirator is quite free from hooklets and contains a definite amount of albuminous material. The treatment of both varieties of cyst is, however, similar, and a mistake in the diagnosis is not of much importance.

(*c*) *Hepatic abscess.*—This condition may be due to the presence of a hydatid cyst which has become the seat of a suppurative process, owing to the conveyance of micro-organisms to the cyst by the blood stream. When suppuration occurs in connection with a hydatid cyst of the liver, there is usually a history of the formation of a slowly-growing swelling in the hepatic region, which in the early stages of its development caused few distinct symptoms, and at a later period somewhat suddenly became tender on pressure and the seat of a throbbing pain. A hydatid cyst of the liver may be distinguished from a hepatic abscess by the fact that the cyst is of slow and insidious growth, whilst the abscess develops more quickly, is tender to pressure, is the seat of throbbing pain, and is accompanied in the majority of cases by the occurrence of rigors and an elevated temperature. In the early stages of hepatic suppuration, sugar can usually be found in the urine, and this is not the case with uncomplicated hydatid disease.

(*d*) *Enlarged and dilated gall bladder.*—When a hydatid cyst of the liver is pedunculated, and attached to the inferior surface of the right lobe, it may be very difficult to distinguish it from a dilated gall bladder, since both swellings are movable in a lateral direction and have an attachment above. Usually the onset of a distended gall bladder is preceded by an attack of jaundice, or biliary colic, or both; and when these symptoms occur they help in making a correct diagnosis. In some cases, however, the gall bladder becomes distended without the occurrence of colic or jaundice, in which case the diagnosis becomes more difficult, and it is necessary to make use of the needle of the aspirator. Pedunculated hydatid cysts of the liver are not common, and distension of the gall bladder, owing to an obstruction in connection with the cystic duct, is much more frequently met with. If a cystic swelling with the characters of a hydatid is present in some other part of the body, it will suggest the possibility of the hepatic tumour being of a similar nature.

(*e*) *Subphrenic hydatid cyst.*—In these cases the entire liver is pressed downwards below the costal margin, and the right pleural cavity is encroached upon. The costal arches which overlie the swelling may also be somewhat everted. It is very difficult, however, to distinguish between a hydatid cyst which is situated in the superior portion of the liver, and one which lies in the subphrenic space.

(*f*) *Subphrenic abscess.*—In this affection the liver is pushed downwards below the ribs, whilst its inferior border maintains its normal outline; there are concomitant signs of an inflammatory process, and on puncture with the needle of an aspirator, pus or purulent matter and gas are withdrawn.

(*g*) *Cysts and soft solid enlargements of the kidney.*—These conditions are liable to become sources of difficulty in diagnosis when they involve the right kidney. In most cases of this kind the enlargement in the loin does not move synchronously with respiration, whilst, if Ziemssen's test is applied, the colon is found to lie along the upper margin of the swelling and not at its lower border, a condition which is constant when an abdominal swelling is in connection with the liver.

(*h*) *Pleural effusion.*—The presence of an effusion into the right pleural cavity, which may either be serous or purulent in nature, is likely to lead to difficulty in diagnosis, especially when both a hydatid cyst of the liver and a pleural effusion are present together. A pleural effusion, when it is extensive, causes bulging of the lower ribs and intercostal spaces, and at the same time fluctuation may be detected in the spaces. The liver is said to be pushed downwards to a greater extent in cases of pleural effusion than in cases of hydatid cyst of the liver or subphrenic space, whilst a hydatid tumour pushes upwards the diaphragm and encroaches upon the space which is normally occupied by the lungs. On percussion of the affected area the thoracic dulness is found to be more localised in cases of hydatid tumour, whilst in pleural effusion it is frequently found to extend over the whole of the basal portion of the pleural cavity. The constitutional symptoms of pleural effusion are more marked and severe than those which are met with in hydatid disease.

(*i*) *Aneurism of the hepatic artery or abdominal aorta.*—

Aneurism of the hepatic artery or of the upper portion of the abdominal aorta gives rise to the formation of a localised swelling which is situated in the hepatic region. This swelling pulsates and is expansile, and on auscultation a distinct blowing bruit can be distinguished. When the hepatic artery is the seat of the aneurism, the common bile duct is invariably pressed upon, and obstructive jaundice results. In cases of aneurism pain is a prominent symptom, owing to the pressure of the swelling upon the nerves.

(*j*) *Cystic ovarian tumour.*—When a cystic tumour of the ovary is very large, and extends upwards from the pelvis to the abdomen proper, so as to reach the hepatic region, it may simulate a hydatid tumour of the liver which involves the inferior aspect of the gland. By careful palpation, however, it can generally easily be made out that the tumour has no connection with the liver, and that it has its point of attachment in the pelvis, whilst an examination of the vagina and the pelvic viscera will help in establishing a correct diagnosis.

(*k*) *Hydatid cyst of the anterior abdominal wall.*—If a hydatid cyst involves the anterior abdominal wall in the hepatic region, it will be found to be situated between the intermuscular planes; it will also be of small size, rarely more than 3 in. in diameter, and sterile. When such a cyst of the abdominal wall is met with, it will be found to be quite distinct from the liver, and will not move synchronously with it, whilst if the tumour is fixed by grasping it with the hand, the liver can be felt to rise and fall with the movements of respiration, movements which are quite independent of any movements of the tumour itself.

(*l*) *Hydatid cyst of the base of the lung.*—A hydatid cyst of the base of the lung cannot readily be distinguished from a similar condition of the upper aspect of the liver. When the lung is the seat of the affection, cough is more common; and if there is any blood in the sputum, it is a fact in favour of lung affection. If there is an area of resonance below the area of dulness, it will point to the lung, although it must be remembered that in subphrenic abscess in which gas has been produced there may be an area of dulness above this, which is due to an empyema. In this latter case the physical signs resemble those of a subphrenic abscess containing gas and associated with an empyema; the symptoms, however, are more acute, they develop more quickly, and are accompanied by an elevation of the temperature of the patient.

(*m*) *Phantom tumour.*—This affection will very rarely require consideration, and if any doubt is entertained, an anæsthetic should be administered, and then, if the swelling is a phantom tumour, it will spontaneously disappear.

(*n*) *Localised abscess of the peritoneum.*—Localised abscesses of the peritoneum may give rise to symptoms which simulate those due to the presence of a hydatid tumour of the liver; and when the hydatid has become the seat of a suppurative process, it is not always easy to distinguish between the two affections. Puncture of the swelling with the needle of an aspirator, and subsequent examination of the evacuated fluid, will, in most cases, enable the surgeon to make a correct diagnosis.

(*o*) *Ascites.*—A very large hydatid cyst may distend the whole of the abdominal cavity, and give rise to symptoms of ascites, in which case puncture and examination of the evacuated fluid, together with the absence of the ordinary causes of ascites, will clear up the diagnosis.

*Frequency of affection of the liver in hydatid disease.*—According to the statistics which have been collected by Thomas,[1] the liver is invaded in 57 per cent. of all cases of hydatid disease. When hydatid cysts are multiple, the liver is nearly always one of the organs to be involved, a fact which has also been shown by Thomas,[1] in whose list of sixty-seven cases the liver was the seat of the parasite in sixty-two.

*Treatment.*—The treatment of hydatid disease of the liver and biliary system is essentially surgical in nature; medicines administered internally appear to have no effect in killing the parasite. Prophylactic measures, however, must be adopted whenever there is any liability of contamination with the ova of hydatids. As we have already seen, dogs form one of the hosts in the life history of the parasite, and sheep also are not uncommonly affected. When such sheep are killed the echinococcus is set free, and if dogs are allowed to eat the offal they become infected; the tape-worm develops within them, and produces ova which are shed into the alimentary canal and voided along with the excreta. On this account dogs should not be allowed to frequent slaughter-houses, and if they become infected they should either be destroyed, or their excreta should be cremated, and means adopted to kill the intestinal parasite. The surgical treatment which has been adopted for the treatment of hydatid disease of the liver has varied considerably at different periods and in the practice of different surgeons. The following are the methods which have been made use of for the cure of the disease.

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[1] Thomas, "Hydatid Disease," 1894.

(1) *Puncture.*—Simple puncture of a hydatid cyst of the liver with the needle of an aspirator or syringe, or with a trocar, and removal of a portion of the fluid contents, has been followed in some cases by a complete cure. It is, however, liable to be fatal in its effects. According to Thomas, statistics which have been collected by various observers show that the mortality in all cases which have been treated in this manner has been 19 per cent., whilst there has been 46 per cent. of failures, and 54 per cent. of reputed successes. The use of the aspirator is said to be twice as safe as that of the trocar. Puncture is liable to be followed by leakage into the peritoneal cavity, which may give rise to the development of peritonitis, or, owing to absorption of certain of the constituents of the contents of the punctured cyst, an urticarial rash and symptoms of ptomaine poisoning may become apparent. On account of the high rate of mortality which has up to the present time been experienced as a result of the performance of this operation, and the uncertainty of its results, it is advised that this procedure should not be adopted as a routine method of treatment. Puncture will be found of great value in the diagnosis of many difficult and obscure cases, but it should not as a general rule be performed unless the surgeon is prepared, if the circumstances of the case demand it, to proceed to the performance of a safer, more radical, and more efficient operation, such as is described later. Some surgeons have injected iodine (a small quantity of the tincture) into the cavity of the cyst, after the removal of a portion of the fluid contents. Others have injected perchloride of mercury, strong carbolic acid, alcohol, ox-gall, or copper sulphate. None of these injection methods can, however, be recommended, since they have a higher rate of mortality than certain of the operative measures which will be described later, and they are much more liable to be followed by a failure to kill the parasite. If an injection method is made use of, perchloride of mercury appears to be the best substance for the purpose.

(2) *The application of caustics.*—Caustics, such as potassium hydrate, or Vienna paste, have been used in the treatment of

hydatid cysts, but the mortality of cases so treated was over 33 per cent., and on this account their use has been discontinued.

(3) *Canule à demeure.*—In this operation a cannula was introdued into a cyst through the abdominal walls, and left *in situ.* As this method was found to be very untrustworthy, and was liable to be followed by suppuration, it is now no longer practised. According to Thomas, the mortality from this method of treatment was over 26 per cent.

(4) *Electrolysis.*—Electrolysis has been made use of in the treatment of a few cases of hydatid disease of the liver. No definite curative powers, however, can be attributed to this agent, since, in the majority of cases which have been so treated, the effects have been those of simple puncture.

(5) *Treatment by incision.*—This is the best and safest method of treatment of hydatid cysts of the liver. It can be carried out in either one or two stages. The operation which is completed at one sitting is the best, and it is the one which it is advised should be made use of in the treatment of all cases of hydatid cysts of the liver. In most cases the operation can be carried out through an abdominal incision, but in the following classes of cases it is requisite to make use of an incision which passes through the lower portion of the thoracic wall, namely, (*a*) unruptured hydatid cysts which are situated upon the superior and posterior convex surfaces of the liver; (*b*) hydatid cysts which have ruptured into the pleural cavity. The details of these operations are given in the chapter which is devoted to a description of Operative Procedures.

(6) *Treatment by excision.*—Tansini has put on record one case in which he dissected out a hydatid cyst from the substance of the liver. The operation was successful. This is an ideal method of treatment, since the whole of the parasite is removed, and the patient recovers much more quickly from the operation than when an incision method is adopted. I have seen one case in which a hydatid cyst was dissected out from the liver, and in which, in order to control hæmorrhage, a ligature was so applied to the liver substance, that it caused occlusion of the portal vein, and the patient died within a few hours from hæmorrhage into the abdominal cavity. The operation has, however, not yet established itself firmly in legitimate surgery; but when the ease with which the liver recovers from simple wounds is taken into consideration, it is quite possible that this may become a

recognised method of treatment. Terrillon of Paris has removed a portion of the liver which was the seat of a number of small hydatid cysts, by means of an elastic ligature, which was fixed around the affected portion of the gland, after he had brought it into the abdominal wound and sutured it to the parietes with silk. This ligature, by exerting continuous pressure upon the base of the protruded portion of the liver, caused it to become gangrenous, and the diseased tissue separated as a slough. This method of treatment, like that of Tansini, has not been carried out successfully in a sufficient number of cases to justify its inclusion in the category of ordinary surgical operations. It appears to be the best method of treatment when the liver is the seat of a number of small hydatid cysts.

*Prognosis.*—The prognosis in a case of hydatid cyst of the liver depends upon a considerable number of circumstances. Usually, however, it is moderately good in uncomplicated cases. It is much better in those cases in which there is no suppuration, than in those in which suppuration has occurred. The situation of the cyst, as regards the liver itself, is of importance; thus, when the cyst is not deeply placed, and it also comes to the surface of the liver where that organ is in direct contact with the posterior aspect of the anterior abdominal wall, the prognosis is favourable. When the cyst is situated in the upper portion of the liver, and comes to the surface of the organ so that it pushes upwards the diaphragm and encroaches upon the thoracic cavity, then the prognosis is more serious, since an operation which is carried out through an incision of the thoracic wall, is more liable to be followed by fatal results than when it is carried out through an incision in the abdominal wall. According to statistics which have been collected by Thomas, the mortality in cases which have been operated upon through the abdomen by the one-stage method of Lindemann has been 10·29 per cent., whilst in a similar class of cases which have been operated upon by the thoracic method, the mortality was 29·4 per cent. A spontaneous cure results in a certain number of cases, owing to the death of the parasite and subsequent shrivelling up of the cyst. Simple puncture has in a few cases been followed by immediately fatal results. In one case of this kind the needle passed through the portal vein, the vein having been pushed forward by the cyst; and in another, death was apparently due to an injury of the solar plexus.

# CHAPTER XI.

## MULTILOCULAR ECHINOCOCCUS OF THE LIVER.

A FORM of hydatid disease has been described by many continental observers, to which they have given the name of "multilocular echinococcus." The affection is characterised by the formation of a tumour, consisting of a considerable number of small vesicles which are embedded in a soft stroma of connective tissue. When the affection was first met with, it was supposed to be a form of "alveolar colloid carcinoma of the liver." Virchow[1] however, in 1856, conclusively showed that the vesicles of the tumour are in reality small echinococcus cysts, and not vesicles containing colloid matter, the result of degeneration in a malignant tumour. This form of hydatid most commonly affects the liver of man. It has been discovered in other viscera, such as the lung, intestine, and peritoneum, in only a few exceptional instances. The lower animals do not appear to be commonly affected.

From the investigations which have been made by Leuckart,[2] Virchow, and Vierordt,[3] it appears probable that the echinococcus multilocularis arises from originally simple bladder-worms, by the formation of localised outgrowths from the external wall of the mother cyst. These buds are covered by a layer of parenchyma, which they push in front of them as they grow outwards. Sooner or later these lateral buds become separated from the original mother cyst, and, being surrounded by the stroma, they come to have the appearance of separate cysts. Leuckart has described a process of growth, in which solid processes originate from the wall of the mother cyst, and become dilated at their distal extremities so as to form secondary daughter cysts. The walls of the cysts have not in every case a spherical form; often they are indented, or folded, or constricted. Multilocular echinococcus of the liver takes the form of a tumour, usually rounded in outline, occupying the interior of the liver, and often projecting upon the surface, and varying in size from a swelling not more than one or two inches in diameter to one which fills the upper half of the abdomen. The tumour is firm and hard, and in many respects resembles more a malignant new formation than a parasite. If a section be made through a tumour of this nature, the surface of the section is seen to be studded with a considerable number of small cavities, somewhat irregular in outline, and separated from one another by a stroma which consists of connective tissue infiltrated with gelatinous material. The wall of each cavity, however, has the structure of an ordinary hydatid cyst. The hepatic tissue in the involved portion of the gland is completely replaced by the new formation, and hence the tumour can easily be made out when it is exposed by an operation. It has been thought that this form of hydatid tumour extends by sending out protrusions along the course of the intra-hepatic lymphatic vessels, but this statement has not been conclusively proved to be correct; and it appears from an examination of sections of the tumour, that the protrusions pass into the intra-hepatic bile ducts and blood vessels in addition to the lymph channels.

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[1] Virchow, *Verhandl. d. phys.-med. Gesellsch. zu Würzburg*, 1856.
[2] Leuckart, "The Parasites of Man," 1886.
[3] Vierordt, *Berl. Klinik*, 1890, No. 28.

*Geographical distribution of the disease.*—According to Vierordt, the affection is most common in Würtemburg, next in Switzerland, and thirdly in Bavaria. Very few cases of the disease have been described, and Vierordt gives the following numbers of the cases which have occurred, namely, Bavaria, thirty-nine; Switzerland, twenty-one; Würtemburg, twenty; Austria, seven; Russia, four; Prussia, two; Baden, one; and United States of America, one. No cases have apparently been recognised in England.

*Symptoms.*—During the early stages of the development of the parasite, few clinical symptoms become manifest from the presence of which the existence of the affection can be surmised. The first symptoms which have been noticed in the early stages are for the most part pains in the gastric region, and often a feeling of fulness accompanied by tenderness on pressure in the epigastric or right hypochondriac regions. Jaundice has been met with in about four-fifths of the recorded cases of patients suffering from multilocular hydatid disease of the liver. The frequent occurrence of jaundice has been thought to be due to the extension of the parasite to the intra-hepatic bile channels. Jaundice in this affection presents no special characteristics. It becomes noticeable on account of the pigmentation of the skin and urine; the occurrence of light-coloured stools, and in the later stages hæmorrhages from mucous membranes or into the tissues. When the disease has existed for several months, an enlargement of the liver may be recognised on examination of the hepatic region, and this enlargement may vary in extent from a small localised swelling, not more than one or two inches in diameter, to a large tumour filling the upper half of the abdominal cavity. When the liver is enlarged as the result of multilocular echinococcus, the diseased portion of the gland is quite hard on palpation, and usually is smooth on the surface. The individual cysts of the parasitic new-formation cannot be felt on the surface of the organ by palpation through the overlying soft tissue of the anterior abdominal wall. Enlargement of the spleen is said to occur in nine-tenths of the patients who suffer from the disease. This enlargement becomes apparent in most cases soon after the appearance of jaundice. When the parasitic infiltration has involved the portal vein, the circulation in this vessel becomes impeded, and œdema of the lower extremities and ascites develop. Diarrhœa may occur in the later stages, and the stools are often stained with blood. Cachexia is said to occur when the disease has existed for some time. According to Vierordt,[1] if the disease is not treated, the patients who are affected with multilocular echinococcus only live from one to two years from the time of the commencement of growth of the tumour. Both males and females seem to be equally affected with the parasite. Of the seventy-two cases which have been collected by Vierordt,[1] thirty-nine were males, and thirty-three females. The greater number of the patients belonged to the middle decades of life, sixty-nine cases being between 27 and 50. The oldest patient was aged 69, and the youngest 19.

*Diagnosis.*—The diagnosis of multilocular echinococcus of the liver appears to be very difficult. The most important points which are of value in making a diagnosis are the occurrence of jaundice, the development of a tumour in connection with the liver, which is hard and presents no signs of its cystic nature, the enlargement of the spleen, and the presence of œdema of the lower extremities, and ascites. The duration of the affection helps to distinguish it from cancer of the liver. The absence of fluctuation in the hepatic tumour is a fact of importance in separating this affection from the ordinary cystic form of echinococcus. Aspiration with the needle of an aspirator usually fails to withdraw any fluid, but in some cases a small quantity is drawn off, which has the chemical characteristics of the contents of an ordinary single hydatid cyst. Often, however, it will be found impossible to recognise the exact nature of the disease until the hepatic tumour has been examined through an abdominal incision. The chief affections from which it has to be distinguished are cancer of the liver, thrombosis of the portal vein, cirrhosis of the liver, hepatic syphilis, and chronic obstruction of the biliary passages, either by an impacted gall stone or by the scar resulting from ulceration induced by a calculus.

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[1] Vierordt, *loc. cit.*

*Treatment.*—Medical measures do not appear to be of any avail in the treatment of this affection. When the disease has been recognised, either after an exploratory laparotomy has been performed, or from external signs and symptoms, the only method of treatment which offers a moderate chance of recovery is local extirpation of the diseased portion of the liver by resection of the organ. Terrillon[1] of Paris has removed a portion of the liver, equal in size to two fists, on account of multilocular echinococcus. The affected portion of the gland was brought into the abdominal wound, and fixed there by the insertion of a ring of sutures. The base of the protruded part was encircled with an elastic ligature. This constriction caused gangrene of that portion of the liver distal to the ligature, and on the seventh day it was removed. The patient recovered. Bruns[2] has also successfully operated upon a similar case.

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[1] Terrillon, "Communication sur la chirurgie du foie," *Bull. et mém. Soc. de chir. de Paris*, 1890, p. 835.

[2] Bruns, "Leber-resection bei multilocularen Echinococcus," *Beitr. z. klin. Chir.*, Tübingen, 1896, Bd. xvii. s. 201.

# CHAPTER XII.

## CYSTS OF THE LIVER.

*Simple or serous cysts.*—Simple (non-parasitic) cysts of the liver are very rare in their occurrence. A number of cases have been described under this name by different observers, but many of them appear to have been sterile hydatid cysts. In the

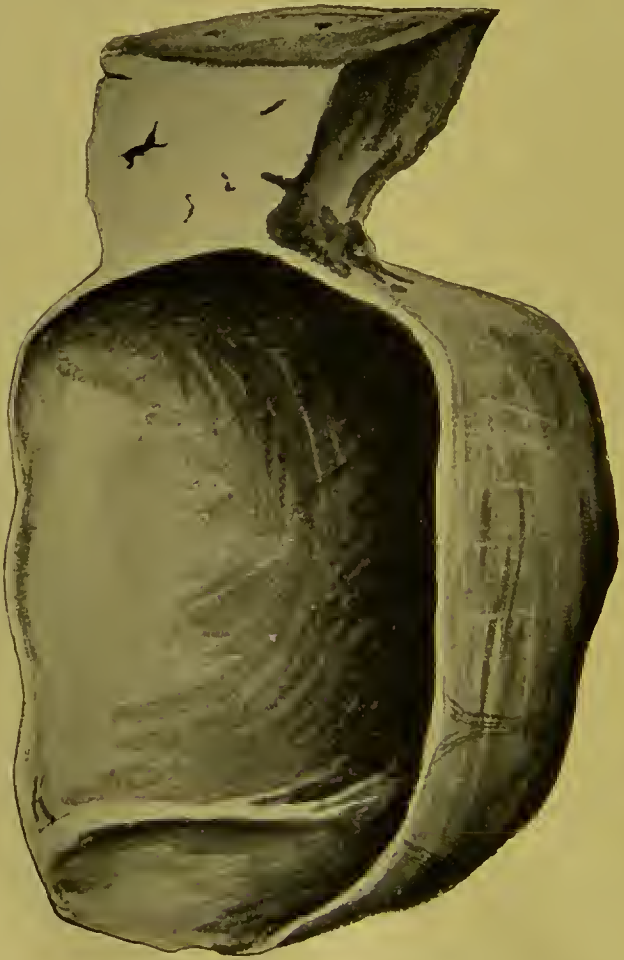

FIG. 21.—Large simple cyst of the liver.—*Roy. Coll. Surg. Eng. Museum.*

Museum of the Royal College of Surgeons of England, there are several specimens of simple cysts of the liver, which do not seem to have been sterile hydatid cysts. Two of these specimens are represented in Figs. 21 and 22. The specimen from which Fig. 21 [1] was taken is a large single cyst, which is attached to the antero-inferior border of the gland, and hangs downwards into the adjacent portion of the abdominal cavity. The second specimen, Fig. 22,[2] is a small cyst about the size of a walnut, attached to the anterior surface of the liver, immediately above and to the right of the fundus of the gall bladder. Each of these cysts has a very thin wall, which consists externally of a layer of fibrous tissue, and internally of a lining membrane, covered upon its internal aspect with epithelium. Both cysts in the recent state were filled with an albuminous fluid, which underwent coagulation on the application of heat. From the nature of their contents, these cysts have been called serous or watery cysts. The exact mode of origin of this variety of hepatic cysts is very doubtful. Some observers have thought that they are dilated lymphatic vessels which from some cause have become obstructed,

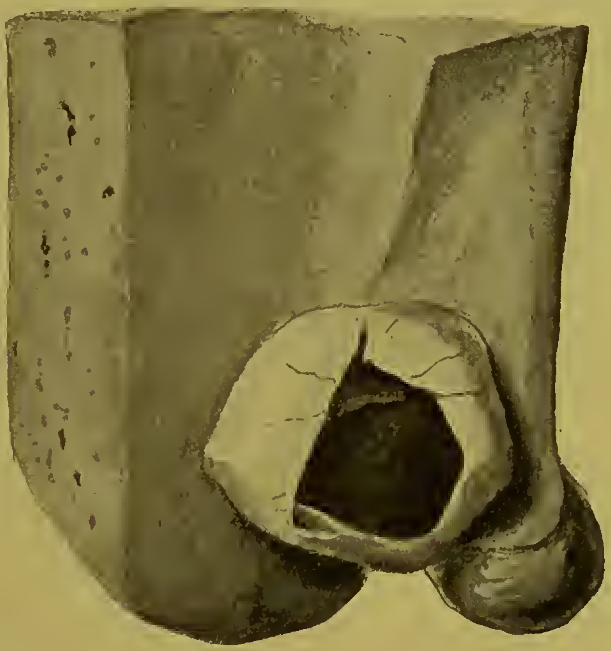

FIG. 22.—Simple cyst of liver, situated on the anterior surface a short distance above the fundus of the gall bladder.—*Roy. Coll. Surg. Eng. Museum.*

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[1] *Roy. Coll. Surg. Eng. Museum*, Spec. 2757a.
[2] *Ibid.*, Spec. 2757b.

and subsequently have undergone considerable dilatation on account of an accumulation of lymph in them, whilst others attribute their existence to the development of obstructions in connection with the commencement of the bile ducts, with resulting dilatation of the proximal parts of these ducts. Others, again, maintain that they are nothing more than old sterile hydatid cysts.

*Symptoms.*—Few if any symptoms are produced by the presence of these cysts in the liver, especially when they do not attain a large size. A few cases have been recorded, such as the one from which the specimen represented in Fig. 21 was taken, in which the cyst has grown and attained considerable dimensions, so as to fill the upper part of the abdominal cavity with a tense fluid swelling, and push aside and displace the neighbouring viscera. The fluid contents of the cysts are albuminous in nature and contain no hooklets, characteristics which help to distinguish them from ordinary hydatid tumours, when an exploratory aspiration has been made. If the cyst grows to a large size it may rupture, and its contents may suddenly pass into the peritoneal cavity, causing shock and collapse. The cysts, however, in the majority of cases, remain small, and do not give rise to symptoms from which their presence in the liver can be surmised.

*Diagnosis.*—When the cysts are large, they may be felt on palpation of the abdomen as tense, fluid, and elastic swellings, situated in the immediate neighbourhood of the liver, to which organ they are attached. They move upwards and downwards synchronously with the respiration. The physical signs are similar to those which are met with in cases of single hydatid cysts. The cysts are characterised by a slow rate of growth, and, when they are aspirated and fluid withdrawn, albumin is found to be present, on the application of heat, whilst no hooklets can be discerned microscopically.

*Treatment.*—When the cyst is large, the treatment which must be carried out for its cure is similar to that which has been recommended in the case of large single hydatid cysts, namely, incision of the abdominal wall over the most prominent portion of the tumour, drawing of the cyst into the wound and evacuation of its contents, and then suture of the aperture in the cyst to the margins of the abdominal wound, and subsequent drainage. When the cyst is a large one, and it is not attached to any of the abdominal viscera by strong adhesions, the greater part or the whole of the cyst may be excised, and if a small portion is left behind the margins are fixed to the abdominal wall, as above. If the cyst is pedunculated, its base may be ligatured at the point where it is attached to the liver, and then the entire cyst can be completely removed from the abdomen, after any adhesions which may be present have been ligatured and divided. In this case no after drainage will be requisite, and the wound in the abdominal wall can be closed at once. In those cases in which the cyst is sutured to the margins of the abdominal wall, recovery will probably be materially hastened by thoroughly scraping the internal aspect of the cyst cavity with a sharp spoon, so as to remove the whole of the epithelium, and promote the formation of adhesions between the opposing walls of the cyst. The prognosis in these cases ought to be very good, since operations carried out on aseptic cases with strict precautions are usually successful. If the epithelium is not removed from the interior, it is possible that the cyst may refill at a later date.

North[1] has recorded a case in which he evacuated a cyst of the left lobe of the liver by a trocar. Five pints of a coffee-coloured fluid were withdrawn. The patient died two days later, and, on making a post-mortem examination, the gall bladder was found to be filled with a large calculus, whilst in the common bile duct two other calculi were discovered. This cyst appears to have been of the character of a retention cyst. Carl Bayer[2] has operated upon a woman, æt. 56, in the liver of whom was a large cyst containing eight litres of fluid. This cyst appeared to have arisen as the result of atrophy of the hepatic acini and subsequent dilatation of the intra-hepatic bile capillaries. The patient recovered. The operation was carried out by making an incision in the right linea semilunaris, opening the cyst, evacuating its contents, and stitching the margins of the aperture in the cyst to those of the parietal incision.

W. Müller has recorded a case similar to that of Bayer, but two-thirds of the cyst wall were excised before the cyst was sutured to the abdominal wound.

*Multilocular cystic disease of the liver.*—This disease is a very rare pathological condition, and when met with it is often associated with a similar condition of the kidneys. It is characterised by the development of a number of cysts of varying size, usually not larger than a walnut, in the parenchyma of the liver. Lejars[1] has collected sixteen recorded cases of this disease, and published them in his thesis in 1888. Individual cases have also been published since this date by Nicolle,[2] Demantke,[3] Pilliet,[4] Sabourin,[5] and Claude.[6] Bristowe[7] and Dmochowski and Janowski[8] have also described cases of this kind.

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[1] North, "A Case of Cystic Tumour of the Liver," *Med. Rec.*, N.Y., 1882, p. 344.

[2] Carl Bayer, "Ueber eine durch Operation geheilte, ungewöhnlich grosse Leberkyste," *Prag. med. Wchnschr.*, 1892, No. 52.

The pathology of the disease does not appear to be the same in all cases, and it is probable that several distinct abnormal conditions are at present included under the term "multilocular cystic disease of the liver." Claude[9] considers that the affection may arise in the following ways:—(*a*) As true biliary cysts, developed by an enormous dilatation of pre-existing biliary canals; (*b*) as mucous cysts, derived from the mucous glands which are found in the biliary passages, owing to a degeneration of these structures; (*c*) as cysts developed from vasa aberrantia; (*d*) as cysts which are derived from a degeneration of the

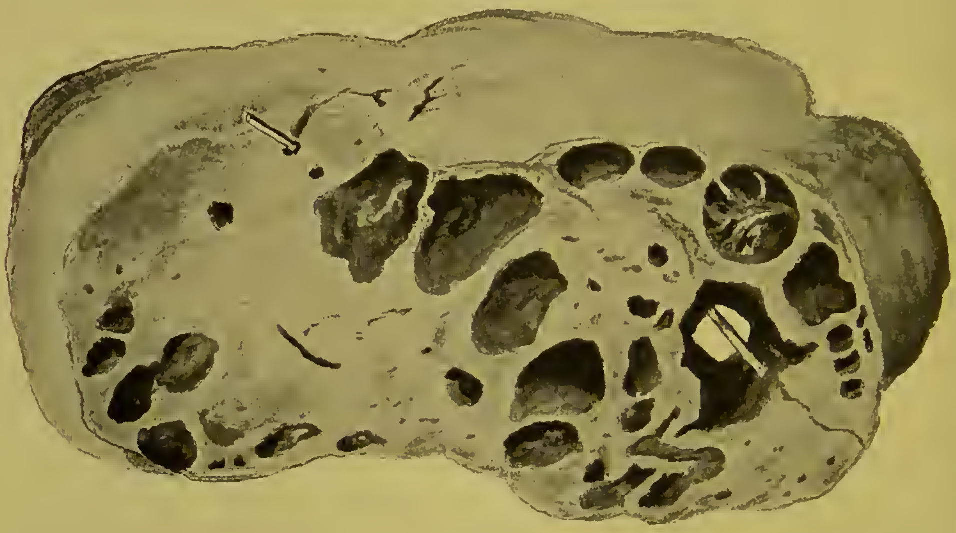

FIG. 23.—Multilocular cystic disease of the liver.—*Roy. Coll. Surg. Eng. Museum.*

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[1] Lejars, Thèse de Paris, 1888.
[2] Nicolle, *Bull. Soc. anat. de Paris*, 1887.
[3] Demantke, *ibid.*, 1893-94-95.
[4] Pilliet, *Tribune méd.*, Paris, 1893.
[5] Sabourin, *Rev. de méd.*, Paris, May 1883.
[6] Claude, *Bull. Soc. anat. de Paris*, 1896, Fasc. 4.
[7] Bristowe, *Trans. Path. Soc. London*, vol. vii. p. 229, and vol. x. p. 174.
[8] Dmochowski and Janowski, *Beitr. z. path. anat. u. z. allg. Path.*, Jena, 1893, Bd. xii.
[9] Claude, *loc. cit.*

hepatic epithelium, and retention of the products of this degeneration. It appears to be probable that most examples of this disease commence as a mucoid degeneration of the epithelial cells of the intra-hepatic bile capillaries, and this is especially so when the kidneys are simultaneously affected. Fig. 23 is a representation of a specimen of a liver which is preserved in the Museum of the Royal College of Surgeons [1] of England, and was taken from the body of a woman who suffered from the disease which is under consideration. The liver has undergone extensive cystic degeneration, and is very much enlarged. When it was removed from the body after death it weighed 13 lbs. 7 oz. The cysts appeared from a microscopical examination to be dilated intra-hepatic bile ducts. The microscopical appearances suggested that the disease commenced as a cellular infiltration, which was followed by the formation of connective tissue around the intra-hepatic bile ducts, and that these structures then became compressed and subsequently dilated. The patient had presented signs of an enlargement of the liver for four years previous to her death, and this enlargement had slowly increased. Both kidneys of this patient were affected in a similar manner.

Several observers (Demantke,[2] Juhel-Renoy,[3] and Wagner) have described a condition of arterio-sclerosis as occurring in multilocular cystic disease of the liver. The middle coat of the arteries and the connective tissue surrounding these vessels within the liver appear to have shown the most thickening, but in one case the branches of the portal vein were also thickened in a like manner.

Multilocular cystic disease of the liver occurs most commonly in old people, and is rarely or never seen in children or young adults. It nearly always occurs in individuals over sixty. No definite train of clinical symptoms is manifested during the course of the affection, but usually a gradual enlargement of the upper part of the abdomen may be noticed, and in the later stages symptoms of uræmia not uncommonly develop when the kidneys are simultaneously involved. The destruction of the secreting part of the hepatic tissue does not progress sufficiently to cause the appearance of symptoms dependent on this condition. Jaundice does not appear to occur in uncomplicated cases of the disease. Most of the cases which have been described have not been definitely diagnosed before a post-mortem examination has been made. Often the patients die of an intercurrent affection, and the disease of the liver is only recognised after death.

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[1] *Roy. Coll. of Surgeons Museum*, Spec. 2758c.
[2] Demantke, *loc. cit.*
[3] Juhel-Renoy, *Rev. de méd.*, Paris, 1881, p. 929.

This disease is only of slight surgical importance, since operative procedures do not seem likely to be able to effect a cure of the abnormal condition, on account of the fact that the entire liver is usually diseased, and the renal organs are also affected.

*Cystic adenoma of the liver.*—Under this name various German observers have described a disease characterised by the development of an adenomatous tumour which arises from the epithelial cells of the liver, or of the intra-hepatic bile channels, and is associated with the formation of a number of cysts. In many respects this pathological condition appears to resemble the affection which we have already described as multilocular cystic disease, but tends in most cases to be more localised, and does not involve the entire liver in so extensive a manner. The lymphatic vessels in the interior of the diseased portion of the organ are said to undergo dilatation during the early stages of the development of the affection. Koenig[1] has placed on record the case of a girl aet. 11 years, from whom he removed a large cystic tumour of the liver. The tumour contained a number of large and small cysts, each of which was lined internally by a layer of cylindrical epithelium, and was described as a cystic adenoma of the intra-hepatic bile canals. Schmidt has also recorded a case of a somewhat similar nature. The patient was a woman æt. 60, from whom he removed a small tumour of the liver which contained a number of cysts. The growth was thought to be a cystic adenoma. Six years after the removal of this tumour, the patient had not suffered from a recurrence of the growth.

*Dermoid cysts of the liver.*—Dermoid cysts, as a primary affection, do not appear to have been met with in connection with the liver. Hulke[2] has described one case of multiple dermoid tumours of the liver. The patient was a woman who came under his observation at the Middlesex Hospital, and who also suffered from dermoid tumours in both ovaries. It appeared probable in this case that the affection of the liver was secondary to the cysts in the pelvis. Some of the cysts appeared to be implanted on the superficial surface of the liver, a condition which suggested that they had reached the liver by means of the peritoneum.

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[1] Koenig, "Handbuch der Spec. Chir." Bd. ii.

[2] Hulke, *Trans. Path. Soc. London*, vol. xxiv. p. 157.

This variety of cyst, either as a primary or secondary affection, appears to be very rarely met with in connection with the liver. When present it is very difficult to distinguish a dermoid cyst of the liver from other forms of cystic swelling, unless the tumour has been aspirated and its contents examined, or explored through an incision in the anterior abdominal wall. If a cyst of this nature is discovered after the performance of a laparotomy, the best method of treatment will be to dissect out the entire tumour from the surrounding hepatic tissue, and then to unite the margins of the wound so produced by deeply inserted silk sutures. In those cases in which it is found to be impossible to dissect out the entire cyst, on account of its deep connections and adhesion to adjacent structures, the superficial surface of the tumour should be incised, the contents evacuated, and the margins of the incision stitched to those of the wound in the abdominal parietes. The whole of the internal aspect of the cyst should also be scraped with a sharp spoon, so as to prevent the possibility of the cyst refilling after the abdominal wound has healed.

# CHAPTER XIII.

## MOVABLE LIVER.

By the term movable liver is implied a condition of the organ in which there is an abnormal amount of mobility. It has only been met with in rare cases, and in these the correctness of the diagnosis has only occasionally been proved at a post-mortem examination, or when the abdomen has been opened and a visual examination of the conditions made. In origin the affection appears to be either congenital or acquired. In those cases which are due to congenital causes, the abnormal amount of mobility of the gland seems to be dependent upon the existence of an elongation of the suspensory lateral and coronary ligaments, or in some rare cases these latter structures, coronary and lateral ligaments, may be found to be absent, the suspensory ligament being the only structure which serves to hold the organ in its usual position. In this latter condition the liver is suspended in a manner similar to that of a pendulum, and oscillates like a body which is in a state of unstable equilibrium. Large projecting lobes or portions of the liver which have been partially separated from the main gland, either as a result of deficiencies in development, or by inflammatory processes or by pressure from without, may simulate in many respects a movable liver. The acquired cases have a variety of causes for their origin. In some of them the gall bladder is the seat of a considerable enlargement, and by exerting traction upon the attached portion of the liver a certain amount of downward displacement and abnormal mobility is produced. Narrowing of the inferior aperture of the thorax, which may be of congenital origin, but in most cases is due to the practice of wearing tightly-fitting corsets, is said to be a frequent cause of displacement of the liver downwards; but in most cases of this kind the pressure which is due to the presence of tightly-fitting articles of clothing causes a constriction of the organ, so that the inferior portion is pushed downwards, the superior part upwards, and only in rare cases are the ligaments lengthened so as to give rise to a true movable liver. Traction from below by tumours or cysts which are attached to the lower part of the gland, may produce a slight amount of lengthening of the ligaments, and hence a moderate amount of abnormal mobility. In women who have pendulous and lax abdominal walls, a condition which is often due to the occurrence of a series of pregnancies following one another in close succession, a variety of movable liver is occasionally met with, which may be associated with a floating kidney or wandering spleen. It occasionally happens, as a result of inflammatory processes in the region of the inferior aspect of the diaphragm and the adjacent part of the liver, that fibrous adhesions are produced which at a later period become elongated, and a condition of abnormal mobility of the liver results. Winkler[1] and Cantani[2] have asserted that a form of fatty degeneration occurs in the tissues composing the suspensory ligaments of the liver, and they consider this condition to be one of the causes of the development of a movable liver. Cantani attributes this degeneration to a change in the tissues of the ligaments, which is induced by a localised peritonitis in the neighbourhood. Segond[3] divides the cases of movable liver into three groups: the first group comprises those cases in which the liver is pushed down by a force acting from above, such as a congenital or acquired narrowing of the outlet of the thorax, wearing tight corsets, cysts or tumours situated on the convexity of the liver, or effusions into the pleural cavity. The second group includes those cases which are dependent upon a diminution in the intra-abdominal pressure, such as a relaxed condition of the interior abdominal wall following pregnancy. In the third group are placed those cases which are due to a change in the liver itself, such as congestive conditions of the organ, new growths, either cystic or malignant, which increase the size and weight of the viscus, and on this account cause an elongation of the suspensory ligaments. Very few well-authenticated cases of true movable liver have been recorded, and on this account it is advisable to regard the pathology of the affection as somewhat uncertain.

[1] Winkler, *Arch. f. Gynaek.*, Berlin, 1872, s. 145.

[2] Cantani, *Ann. univ. di med. e chir.*, Milano, 1866, p. 373.

[3] Segond, Duplay et Reelus, "Traité de Chir." Paris, vol. vii.

*Symptoms.*—A movable liver may give rise to no symptoms which inconvenience the patient, or the condition may cause a series of troubles which render the life of the affected individual very unpleasant. Dragging pains in the hepatic and abdominal regions are usually of frequent occurrence, and there may be paroxysms of severe pain and occasionally an attack of jaundice. On making a physical examination, a tumour can usually be felt in the abdomen, extending downwards even beyond the umbilicus or into the right iliac fossa and the hypogastric region. This tumour has the size and shape of the liver, and on manipulation it can generally be made to occupy the position in which the liver is normally situated. On percussion, the right hypochondriac region is found to be resonant and occupied by the intestines. In cases of movable liver, digestive derangements appear to be common, whilst difficulty in walking may be experienced which may prevent the patient following her ordinary occupation. In most cases in which a condition of movable liver is supposed to exist, it will be found very advisable to examine the patient under an anæsthetic before making a definite diagnosis. By this proceeding it is often possible to avoid errors of diagnosis which would otherwise be made.

*Diagnosis.*—The condition of movable liver is met with most commonly in the female sex, males being very rarely the subject of the affection. When a tumour which has the shape, size, and consistency of the normal liver, is present in the lower portion of the abdomen, and at the same time the hepatic region is occupied by structures which are resonant on percussion, it is probable that a case of movable or displaced liver is under consideration, and a diagnosis of this nature may be made, especially in those cases in which the tumour can be replaced in the hepatic region (Thierfelder).[1] Great care, however, must be taken in the examination of a patient before such a diagnosis is made.

*Treatment.*—If the displaced liver can be replaced in its normal position in the upper part of the abdominal cavity, and retained there by the application of a suitable belt or other mechanical contrivance, this should be done, and under these conditions no operation advised. If the abnormal position of the liver is due to traction caused by a distended gall bladder, a cholecystostomy should be performed, the distended viscus evacuated, and then stitched to the anterior abdominal wall. In those cases in which the displacement is due to the pressure of tightly-fitting corsets, their use must be discontinued at once. When the affection is due to traction, caused by the presence of a cyst or tumour, the cause should be treated by appropriate surgical measures. If the ligaments of the liver are much elongated, and the symptoms which are due to the condition of abnormal mobility become a source of considerable annoyance to the patient, and at the same time cannot be remedied by the application of a belt, it is justifiable to advise the performance of a surgical operation to fix the liver in its usual position. This operation is called hepatopexy or hepatorraphy. It may be partial or complete, according to whether the entire gland or only a part of it is displaced and requires fixation. Langenbuch[1] and Tschering[2] have successfully performed the partial operation, and Gerard-Marchant[3] the complete one. Richelot[4] and Lannelongue[5] have recorded cases of hepatopexy which have been followed by good results. Richelot recommends that the incision of the abdominal wall should be made in the linea alba or in the right semilunaris. The method of performing these operations is discussed in Chapter XXIII.

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[1] Thierfelder, *Deutsches Arch. f. klin. Med.*, Leipzig, Bd. xiv. s. 146.

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[1] Langenbuch, *Berl. klin. Wchnschr.*, 1891, No. 3, s. 68.

[2] Tschering, *Centralbl. f. Chir.*, Leipzig, 1888, No. 23.

[3] Gerard-Marchant, "Hepatopexie," *Bull. Acad. de méd.*, Paris, Août 11, 1891.

[4] Richelot, "Fixation d'un foie déplacé," *Union méd.*, Paris, Août 5, 1893.

[5] Lannelongue in Conturier's Thèse de Bordeaux, 1894.

# CHAPTER XIV.

## TRAUMATIC AFFECTIONS OF THE LIVER.

Injuries of the liver, gall bladder, or biliary ducts, when met with in surgical practice, are often found to be associated with similar injuries of either one or other of the neighbouring thoracic or abdominal viscera. The traumatic agencies which cause the injury to the liver may be either penetrating or non-penetrating in character. Those traumatic affections which are due to non-penetrating injuries are either of the nature of contusions or of ruptures, and are due to some variety of violence or mechanical force, directly or indirectly applied, which has been severe enough to effect a rupture of the liver substance, but has not destroyed the continuity of the overlying tissues. These affections may be caused by severe crushing of the abdomen, as in buffer accidents; by wheels of heavy waggons or vehicles passing over the abdomen; by heavy bodies, such as logs of timber, falling upon the hepatic region of the abdomen; by blows upon the abdomen with blunt instruments, by kicks in the abdomen; by falls from a considerable height, even when the patient alights upon his feet; and by blows upon the head and shoulders, the effects of which are transmitted to the region of the liver. In a few recorded cases, injuries of this nature have been caused by the fracture of one or more ribs, owing to the driving inwards of the fragments so as to cause a laceration of the underlying portion of the liver. The severity of the injury which follows the application of traumatism to the liver depends to a certain extent upon the condition of the liver tissue at the time of the infliction of the injury. Thus, when the liver substance is hard and slightly cirrhosed, or rather more fibrous than usual, it will be able to withstand the application of a mechanical force easily, and without suffering much damage; but in those cases where the gland has undergone fatty degeneration, or is engorged with blood and lymph, and hence is much softer and more friable than is normally the case, severe ruptures or contusions are readily produced. The fibrous tissue which forms the chief constituent of Glisson's capsule assists the liver to withstand slight injuries. If, after the application of mechanical violence, the liver substance which lies immediately underneath the capsule of Glisson undergoes a solution of continuity without the occurrence of a simultaneous rupture of the capsule itself, then a contusion of the liver is said to take place. In this case, several of the smaller blood vessels of the liver are ruptured, hæmorrhage takes place from them, and causes the damaged portion of the gland to become infiltrated with an effusion of blood, and if the organ is examined it is found to present the appearance of one or more ecchymoses upon its surface. In the Museum[1] of Guy's Hospital there is the liver of a woman in whom an extensive subcapsular hæmorrhage had developed, apparently as the result of severe vomiting. The woman was advanced in pregnancy at the time. A contusion of the liver of this kind is one of the causes of hepatic abscess. If the injury is more severe, both the capsule of Glisson and the underlying portion of the glandular tissue undergo a solution of continuity, and a rupture is produced. This rupture may be small and affect only a limited portion of the substance of one lobe of the gland, or it may be extensive, causing partial or complete separation of a large piece of one lobe or even a lobe itself from the remainder of the organ. Thus, in a few recorded cases, after the infliction of severe injuries, a portion of the liver has been found lying free in the peritoneal cavity.

*Situation of the contusion or rupture.*—Those affections of the liver which are due to the application of direct violence, are located, in the majority of instances, opposite the point where the injury was received; but this is not invariable, and the different statistics which have been collected in order to elucidate this point do not agree as to which is the commonest situation of the injury. Thus, in Mayer's[2] list of eighty-five collected cases, fifty-four were located in the right lobe, twenty-one in the median portion, and ten in the left lobe; and in Ogston's list of twenty-six cases, eleven were in the right lobe, six in the left, and nine in the median portion. In some cases the portion of the liver which is the seat of the rupture is the most protected part. This condition is brought about by a forced doubling of the gland upon itself. This is especially the case where the upper and posterior portion of the right lobe is ruptured as a result of external compression.

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[1] *Guy's Hosp. Museum*, Spec. 1246.

[2] Mayer, "Die Wunden der Leber und Gallenblase," 1872.

*Form and shape of the rupture.*—Out of twenty-two fatal cases of hepatic injuries which have been collected by Dr. Frederick Taylor, fourteen cases were extensively injured, and in six the liver was divided partially or completely in an antero-posterior direction, whilst in eight the injury extended in various directions. The shape of the laceration may be either sagittal, transverse, oblique, or stellate. In the majority of instances it is either in an antero-posterior direction, or it is stellate in form. When a rupture of the liver is caused by the driving inwards of a fractured rib or ribs, the injury, in most cases, is multiple, and presents the appearance of a superficial lacerated wound, but occasionally it may extend for some distance into the viscus, and is then of the nature of a punctured wound.

*Symptoms.*—In cases of rupture of the liver, a variable amount of shock usually follows immediately upon the reception of the injury, and tends to mask the symptoms which are more directly due to the injury to the liver. In very severe cases, a state of collapse may be induced from which the patient does not recover. In those cases in which the liver suffers a considerable amount of laceration, or in which a large portion of one lobe is separated, symptoms of severe internal hæmorrhage develop at a very early stage, and render the diagnosis obscure. The symptoms which follow an injury to the liver, and which help to localise the affection to the hepatic region, are—

(*a*) *The nature and the point of application of the mechanical force which causes the injury.*—Thus, if a mechanical force is applied directly over some part of the hepatic area, it will suggest the probability of the liver being the seat of injury. In many cases, however, it is not possible to ascertain how and where the injury has been inflicted, owing to the loss of consciousness which has immediately followed the injury. In some cases there are signs of bruising of the hepatic area, or even ecchymoses and subcutaneous hæmorrhage, in which cases it is probable that damage to the liver has taken place, provided that there are also symptoms of internal hæmorrhage and pain in the hepatic region.

(*b*) *Pain.*—This is generally most marked in some part of the hepatic region, and often radiates either towards the umbilicus, the ensiform cartilage, or the inferior angle of the scapula. Some observers have attempted to localise the part of the liver in which the injury is situated from the direction of the radiating pains, but apparently without sufficiently trustworthy grounds upon which to base their theories. Thus, Boyer[1] says that pains which radiate towards the scapula point to the existence of lesions upon the convex surface of the organ, whilst those which radiate towards the umbilicus indicate the concave surface as the seat of the injury. The character of the pain varies in intensity, and it may be either constant or intermittent, but rarely the latter. It is intensified during movements, and when pressure is exerted over the area of the injured portion.

(*c*) *Vomiting.*—This symptom is often present, and the ejected material is usually coloured with bile.

(*d*) *Jaundice.*—Jaundice is only occasionally met with in ruptures of the liver, and when present it usually commences to develop on the second or third day after the reception of the injury. In 249 cases of injuries to the liver collected by Ludwig Mayer, jaundice occurred twenty-four times.

(*e*) *The character of the respiratory movements.*—The movements of the abdominal walls are considerably diminished, or are even entirely absent, and the respiration becomes costal in character.

(*f*) *Symptoms of internal hæmorrhage.*—Hæmorrhage is the most important and constant concomitant of rupture of the liver. In contusions it is small in amount, and is limited to a small area underneath the capsule of Glisson, but in those ruptures which involve the surface of the organ, blood passes into the peritoneal cavity, and may be so considerable in quantity as to cause the development of an obvious swelling in the abdomen. This swelling is fluid in character, and at first is localised to the upper part of the abdomen, but it may gradually increase in size and ultimately occupy a considerable portion of the abdominal cavity. The development of a tumour of this kind is accompanied by the manifestation of all the symptoms of internal hæmorrhage, and in fact it may be said that signs and symptoms of hæmorrhage are the most important in all varieties of injury to the liver. If the hæmorrhage is severe, and is unchecked by surgical or other means, a fatal result quickly follows. The hæmorrhage is much more severe when the inferior aspect of the gland is the seat of the injury than when the upper surface is affected.

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[1] Boyer, quoted by Morris, "Encycl. of Surg.," vol. v.

(*g*) *Signs of shock and collapse.*—Signs and symptoms of shock and collapse are manifest in nearly all cases of injury to the liver. They vary in intensity according to the severity of the injury, and, as we have already seen, they may mask the symptoms which otherwise would help to localise the organ which has been damaged.

(*h*) *Condition of the urine.*—The examination of the urine may reveal the existence of a small quantity of bile, or of sugar. Sugar is said to be frequently found in the urine after a contusion of the liver. Its presence, however, is only transient, and it soon disappears if the liver returns to its normal condition.

*Diagnosis.*—If the patient affected comes under observation with the history of the infliction of an injury, especially when it has been applied over the region of the liver, and this is followed by the occurrence of shock, and at a later period by the formation of a fluctuating swelling in the abdomen, which swelling gradually increases in size, and is associated with the symptoms of internal hæmorrhage, then it will be probable that he is suffering from a rupture of the liver. Contusions and small ruptures are suggested by the character of the injury, and the occurrence of pain in the hepatic region, which radiates towards the umbilicus, the ensiform cartilage, or the inferior angle of the scapula. Marshall[1] relates a case in which a portion of the liver became detached as the result of the severity of the injury, and passed into the circulation, becoming impacted in the pulmonary artery immediately above the valves. The portion of liver weighed 4 grms. The patient died forty minutes after the reception of the injury. Zenker and Schmorl have related similar cases, all of them being fatal. When the rupture is slight, and only a small amount of localised hæmorrhage takes place, few localising symptoms may become apparent beyond pain in the region of the liver and a variable amount of shock.

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[1] Marshall, *Lancet*, London, Feb. 7, 1874.

In these slight cases, however, if the part which has been injured is auscultated with a stethoscope a few days after the injury, it will be possible to hear friction sounds during the movements of respiration, which are due to the development of a localised plastic peritonitis. In some cases it happens that suppuration occurs, and signs of a hepatic abscess develop. Hamilton[1] has recorded a case in which a patient fell from a considerable height on to his right side, but after the accident was able to walk. About an hour afterwards he suffered from severe angina, with embarrassment of the respiration, and died in a short time in a condition of coma. Post-mortem the liver was found to have been ruptured in several places, and also to be fatty. In the lung the small and medium-sized branches of the pulmonary artery were found to be occluded with fat, which stained with osmic acid.

*Treatment.*—The plan of treatment which is to be adopted in the case of injuries of the liver depends upon the character and severity of the injury, and especially upon the amount of hæmorrhage which results. In many cases the first treatment which is requisite is that which has for its object the abatement of the symptoms of shock and collapse. The patient should at once be placed in bed and kept absolutely quiet; warm bottles are applied, and if there is evidence of a feeble pulse hypodermic injections of strychnine should be given. It is not advisable to administer alcohol or ether in any form, since both substances dilate the peripheral blood vessels, and tend to increase the hæmorrhage, if any is present. After the patient has recovered from the symptoms of shock and collapse, complete rest in bed for a period should be enjoined, especially in those cases in which the injury has been of a severe character. If no signs of the occurrence of internal hæmorrhage develop, rest in bed, combined with careful nursing, will in most cases be followed by a recovery. During the time the patient is confined to bed opium should be administered in small doses, and nourishing food in small quantities. Those foods, such as beef tea, which contain a considerable amount of extractives should not be given during the early stages, since they throw an increased amount of physiological work upon the liver. Milk given in small quantities, and diluted with soda water or plain water, will be found to be the most useful article of diet at first.

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[1] Hamilton, *Brit. Med. Journ.*, London, Oct. 6, 1877.

When signs and symptoms of hæmorrhage into the peritoneal cavity develop, and gradually or quickly become more manifest, it is necessary in most cases to have resort to the performance of a surgical operation. The skin of the abdominal area must be rendered aseptic by one of the ordinary methods, and then the abdomen is opened. The incision through the abdominal walls is usually made in the middle line, but this will be decided when a careful examination of the region of the greatest localised enlargement or swelling has been investigated. In many cases it will be found quite impossible to locate exactly the position of the rupture in the liver, and under such circumstances the abdomen must be opened by an incision which commences at the ensiform cartilage above, and extends downwards over the linea alba towards the umbilicus for about three or four inches. All bleeding which is the result of the incision in the abdominal walls should be arrested before the peritoneal cavity is opened. When this has been done, an attempt is made to localise the situation of the injury. All blood clots or collections of blood should be removed, and if hæmorrhage is still taking place, it must be traced to its source, and temporarily arrested by means of sponge pressure and packing with aseptic plugs of gauze. If any bleeding vessels are met with, and they can be ligatured with fine silk, this must be done. Much help may be derived, in establishing a correct diagnosis in cases of severe injury, by making a chemical examination of the fluid effused into the peritoneal cavity, so as to definitely ascertain whether bile is present or not. When evidence of the presence of free bile in the blood which has passed into the peritoneum can be obtained, it points to the existence of an injury to the liver or one of the biliary ducts. If the liver is found to be the seat of the hæmorrhage, the locality, extent, nature, and character of the injury must be ascertained. In order to do this satisfactorily, it will usually be found necessary to enlarge the incision in the abdominal wall, and this should be done in a downward direction. If either the anterior or inferior surface of the liver is seen to be the seat of the injury and the area from which hæmorrhage is taking place, it will usually be found possible to deal at once with the injury through the median wound of the anterior abdominal wall. The liver should be raised as far forwards as possible by packing the lower aspect with sponges, and by traction and slight rotation, if requisite, by the hands of the surgeon's assistants, until the injured area is brought immediately opposite the aperture in the abdominal wall. If the rupture is linear, and does not extend to a very great depth, it should be dealt with in the following manner:—All adherent clots are carefully removed from the injured parts by sponging, and if any bleeding points can be seen, these are ligatured with fine silk. The margins of the rupture are then brought as far as possible into exact apposition, and then fixed together by the introduction of a row of sutures. Either silk or medium-sized catgut can be used for this purpose, but it will be found that silk is much easier to introduce, and it is less liable to slip afterwards. The sutures are introduced with a Hagedorn's needle, of such a shape that the long edge of the point is parallel with the margin of the wound. The point of the needle is entered about one-third of an inch from the margin of the rupture, and is first carried to the bottom of the wound through the liver tissue, and then made to pass through the opposite margin of the wound but the same distance from the wound. The sutures are placed about a third or a quarter of an inch from one another, and all are introduced before any of them are tied. After the entire row has been introduced, each one is tied separately, and the free ends are cut short. Great care must be taken in tying these sutures, so as to prevent any tearing of the liver substance. They must be tied only just tight enough to hold the margins of the rupture in close apposition along the entire length of the wound. After the hæmorrhage has been arrested in this manner, and when there is no further sign of bleeding, the surrounding peritoneal cavity is thoroughly cleansed of all blood clots and other extraneous matter, and then the wound in the abdominal wall is closed in the usual manner. If there is any oozing of blood from the margins of the rupture, or from the perforations of the liver substance which have been made by the introduction of the sutures, it may be necessary occasionally to introduce a drainage-tube or strip of aseptic gauze into the bottom of the wound, and leave it there for the first twenty-four hours, at the expiration of which period it must be removed. In most cases, however, this will not be required, as the hæmorrhage usually entirely stops after the sutures have been put in and tied. Experimentally, I have performed this operation upon healthy cats after the liver had been ruptured by violence. In all the cases which were operated upon in this manner perfect healing and recovery took place. When the liver is found to be the seat of several ruptures, it is not always possible or practicable to deal with the various solutions of continuity in the gland in the manner above described. If any small ruptures are seen in the exposed surface of the gland, it is sometimes possible to arrest the hæmorrhage by the insertion of a "purse-string" suture, such as is shown in Fig. 23 *a*. This form of suture is only of use in small lacerated wounds. If the hæmorrhage has ceased naturally, as happens occasionally, the clots of blood should be removed, and the wounded area should be packed with tampons of sterilised gauze, whilst the wound in the abdominal wall is partially closed, a portion being left open through which the plugs of gauze can be afterwards removed, and fresh ones inserted if necessary. The tampons should in any case be removed at the end of twenty-four to forty-eight hours, and sooner still if there are any signs of fresh hæmorrhage, or of the occurrence of septic infection of the wound. All these procedures must be carried out under the strictest aseptic precautions, so as to avoid as far as can be done the infection of the wounded area with the micro-organisms of suppuration. If it is found impossible to obtain a free exposure of the wound in the liver by means of the median vertical incision through the anterior abdominal wall, it may be requisite to make a further incision, either along the inferior border of the right costal margin, or even to resect portions of the lower ribs. When the left lobe

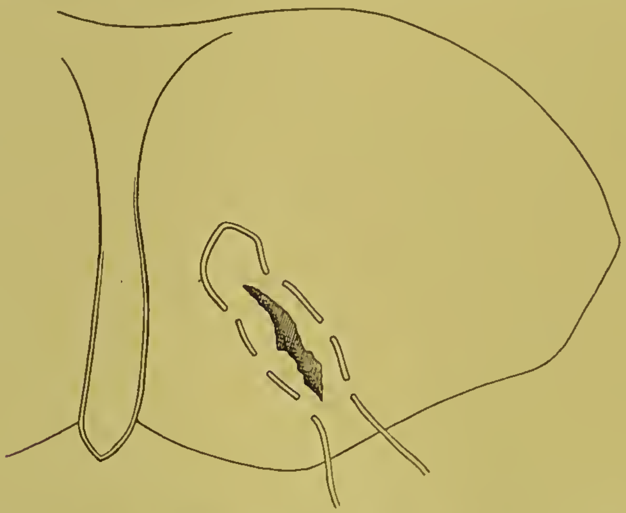

FIG. 23*a*.—Method of inserting a "purse-string" suture for a smal rupture of the surface of the liver.

of the gland is alone injured, it will in almost every case be found possible to deal with the injury through a median incision in the linea alba. Schlatter[1] has recently recorded a case in which he had to make an incision along the right costal margin, and was able to suture a rupture which was situated close to the lobulus Spigelii, and to arrest the hæmorrhage, which had been very severe. The patient, however, died owing to loss of blood and shock consequent upon the injury and this operation, although it was attempted to combat this by means of transfusion of salt solution. Professor Krönlein[2] has operated upon a case in which the left lobe was separated owing to a total sagittal rupture. The injury was followed by hæmorrhage and escape of bile into the peritoneal cavity. Fourteen days after the occurrence of the injury, the abdomen was opened, and an attempt was made to suture the injured portion of the liver, all blood and bile being first removed from the peritoneum. The patient died shortly afterwards from shock and collapse. If hæmorrhage is found to be still going on, and to be dependent upon severe injury of the liver, it is probable that surgical measures for its arrest will be difficult of application. When the peritoneal cavity has been opened, the injured area of the liver should be freely exposed, so as to enable the surgeon to deal with it satisfactorily. In order to do this, it will be requisite in many cases to make a second incision along the right costal margin, or even to resect portions of the lower ribs. When this has been done, all blood is to be removed from the area of the operation, and, if possible, the bleeding should be stopped by temporary pressure with sponges. If any bleeding points or the open mouths of blood vessels can be seen, they should be closed by the application of fine silk ligatures. It is somewhat difficult to apply ligatures in this manner, owing to the friability of the hepatic tissue. Some surgeons have made use of the thermocautery for the arrest of parenchymatous hæmorrhage from the liver, but it is doubtful whether it is advisable to adopt this method of treatment, since it is followed by the death of a layer of tissue, which must separate or become absorbed before healing can take place, and it is liable to be followed by secondary hæmorrhage. Parenchymatous hæmorrhage of this nature can usually be as effectually arrested by the application of tampons of sterilised

[1] Schlatter, *Beitr. z. klin. Chir.*, Tübingen, Bd. xv. Heft 2, s. 531–562.
[2] Krönlein, quoted by Schlatter as above.

gauze; and there is not the same risk of the occurrence of a localised gangrene or of secondary hæmorrhage. In a course of experimental investigations which I have carried out in the laboratories of the Royal College of Surgeons, I have found that it is possible to deal with severe ruptures of the liver which involve the partial or almost complete separation of an entire lobe in the following manner:—After opening the abdominal cavity and exposing the injured portion of the liver, an elastic rubber tube is passed around that part of the organ in which the ruptures are situated. The tube is then tightened sufficiently to control the circulation in the blood vessels and temporarily arrest the hæmorrhage. This rubber tube is given to an assistant to look after, and then the operator takes a sharp scalpel and quickly removes the injured portion of the liver by means of a wedge-shaped incision. Sponges are applied to the incised surface, and any bleeding points which can be seen are clamped with fine artery forceps whilst the ligatures are being applied. The margins and surfaces of the wound in the liver are then brought into exact apposition, and fixed by the introduction of a row of sutures, each suture being applied after the manner which was recommended in the case of linear ruptures. When all the sutures have been introduced, they are tied and their ends cut short. The elastic ligature is then removed, and the liver is allowed to drop back into its place in the abdomen. A small amount of hæmorrhage may occur from the points of insertion of the sutures, but this soon stops. The peritoneum is then washed out, and the abdominal wound closed. I have carried out this operation a number of times on cats and dogs, and have found that in most cases it has been followed by a successful result. In one case, in which I made use of catgut sutures alone, I found that some of them gave way, and this accident was followed by hæmorrhage and the death of the animal. Silk sutures appear to be the best for the purpose. This procedure, however, has not yet, as far as I am aware, been tried in the treatment of ruptures of the liver in man; but it seems possible, from experiments which have been made on animals, that it may be made use of in selected cases.

If a portion of the liver has been detached completely from the rest of the organ by the force of the injury, it must be removed from the abdomen, and the injured surfaces brought into apposition if possible, and fixed with sutures. When this condition occurs, it will usually be accompanied by severe internal hæmorrhage, which causes a serious state of the patient, owing to the development of shock and collapse dependent upon the loss of blood, so that it is not possible to perform a prolonged and extensive operation for the relief of the injury. In a few cases of this kind, however, especially when the apex of the left lobe is the seat of the injury, it will be possible for the above-mentioned procedure to be carried out, and a favourable result may be expected to follow. It will be found much easier to pass an elastic ligature around the left lobe for the control of hæmorrhage than around the right lobe.

*Penetrating wounds.*—Penetrating wounds of the liver are only occasionally met with, and are due most commonly to either one or other of two causes: they are either the result of a stab with some sharp instrument, such as a knife or a bayonet, or they are caused by the penetration of projectiles discharged from firearms. In very rare cases, blunt bodies, such as the shaft or centre pole of a cart or waggon, have been the cause of penetrating wounds of the liver. Ludwig Mayer[1] has collected cases of penetrating wounds of the liver from various sources, and finds records of twenty-one cases which have recovered from stabs. Punctured and incised wounds vary in position, size, and extent, according to the form, direction, and mode of application of the instrument which produces the injury. Thus some wounds, such as stabs with penknives, may be small and only penetrate the superficial surface of the liver; whilst others, such as those which are due to bayonet wounds, or to wounds which have been inflicted with a homicidal intent (as in the case of the late President of the French Republic), may be wide or pass through the greater part of one lobe, and divide large branches of the portal or hepatic veins, or even the inferior vena cava itself. This kind of wound is met with much more frequently in military than civil practice.

*Gunshot wounds.*—These injuries differ considerably in severity, owing to the varying characters and size of the projectiles which cause the injury. In some cases there is only a slight superficial grazing or grooving of the peritoneal and fibrous coverings of the viscus and the underlying hepatic substance, whilst in others there may be deep perforations and extensive lacerations which pass through or involve the greater part of one or other lobe, or both lobes may even be simultaneously damaged, or in very severe cases a portion of the liver may be reduced to a pulp. These differences are due in the main to the size, shape, velocity, and direction of the missile which causes the injury. According to Otis, when the projectile is discharged from a firearm which is located in the immediate neighbourhood of the individual who is injured, a considerable and widespread laceration is the almost invariable result, even when the ball is discharged from a pistol or a rifle. These injuries are often complicated, owing to the presence of foreign bodies, such as the projectile itself, or particles of clothing, or portions of the bony ribs, which have been carried inwards by the force of the injury.

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[1] *Loc. cit.*

*Lacerated wounds.*—These affections are usually due to the perforation of a blunt body from without. The shaft of a carriage, the centre pole of a cart or waggon, or the penetration of iron or wooden palings upon which a patient has fallen, have been known to be the cause of these injuries. They are very rare, and when met with are commonly fatal, on account of the severity and extensive nature of the injury. The patient usually dies from shock and primary hæmorrhage.

*Frequency.*—Punctured, incised, and gunshot wounds of the liver are much less frequently met with than ruptures and contusions. They are seen for the most part in military practice, but occasional cases of homicidal or suicidal wounds of the liver, which have been caused by sharp instruments or by the ball of a revolver or other variety of firearm, are met with in both Hospital and private practice. Lacerated wounds which are the result of perforation of the upper abdominal region with a blunt body, are also very rare. Incised wounds of the liver are occasionally made intentionally by the surgeon in the treatment of abscesses or parasitic cysts, and in the removal of hepatic tumours.

*Symptoms.*—Hæmorrhage, which is either internal or external, and its consequences, are the usual symptoms which become prominent after the infliction of penetrating wounds of the liver. When the wound upon the external surface of the body is large, and communicates directly with the wound in the liver, there may be a considerable amount of external hæmorrhage, but in the majority of cases it is found that the track of the penetrating body becomes somewhat closed, owing to the approximation of the margins of the aperture; and then the greater portion or all of the effused blood passes into the peritoneal cavity, and gives rise to the symptoms of internal hæmorrhage. Lacerated wounds of the liver, owing to the fact that they are of considerable extent, are usually accompanied by more severe hæmorrhage than clean incised wounds, unless it happens that in the latter case one or more branches of the portal or hepatic veins have been cut across, or the inferior vena cava itself has been injured. If the hæmorrhage which follows the reception of the injury is very severe, the symptoms of collapse and shock may obscure all other symptoms. In many cases, however, pain is found to be present; it is usually dull in character, and radiates either upwards towards the shoulder or the neck, or downwards towards the ensiform cartilage and the umbilicus. It is said to radiate upwards in the case of injuries of the superior aspect of the gland, and downwards when the inferior surface is involved. The location of the pain, however, does not in all cases indicate the position of the injury. A discharge of bile or bile-coloured fluid from the external wound occasionally accompanies penetrating hepatic injuries, and when it is met with it indicates the existence of an injury to one of the larger hepatic ducts, or of a simultaneous injury to the gall bladder. It is not necessary in these cases that one of the extra-hepatic ducts should be involved, as injury of the larger intra-hepatic ducts is followed by an escape of bile. Vomiting is an occasional symptom in these cases, and, when the stomach is also injured, blood and possibly bile will be found in the ejecta. The respiration is usually laboured, and tends to be costal in type on account of the injury to the abdominal organs. Hiccup may be present, and is very annoying to the patient. If a patient who has received a perforating wound of the abdomen or thorax, which involves the liver, does not die at an early stage after the reception of the injury, and the injury has not been treated by active surgical measures, the following symptoms may arise, namely, (*a*) distension of the abdomen and tympanites; (*b*) rigors at irregular intervals; (*c*) delirium; (*d*) peritonitis; (*e*) secondary hæmorrhage; and (*f*) abscess of the liver. Although early surgical treatment in many cases will tend to prevent the occurrence of the above unpleasant complications, in a certain number of patients these cannot be avoided.

*Diagnosis.*—The position, and especially the direction of the penetrating wound which causes the injury of the liver, are most important points upon which stress must be laid in establishing a correct diagnosis, whilst the escape of bile or bile-stained fluid from the external wound also affords important information. If the external wound is situated upon the right side of the body, below the level of the sixth intercostal space, and its direction is horizontally inwards or obliquely downwards, the liver must be implicated if the instrument has passed inwards to any considerable depth; and if the wound is situated in the right hypochondriac region and below the costal margin, and its direction is obliquely upwards, the liver will usually be found to be damaged. If there is an escape of bile or bile-coloured fluid from the wound, this occurrence will point to the existence of an injury of some portion of the liver or the biliary system. When the liver can be distinguished at the bottom of an external wound, and its surface can be seen to have suffered a solution of continuity, the diagnosis will be apparent. If the external wound is situated over some part of the liver, and its infliction is rapidly followed by the development of symptoms of internal hæmorrhage, it will in all probability be found that the liver is the organ which has been injured and has given rise to hæmorrhage. In some cases it will be found almost impossible to arrive at a correct diagnosis, owing to the external wound being situated far from the hepatic region, and the uncertainty which exists concerning the direction which the penetrating instrument or missile has taken. This is especially the case when the injury is due to a gunshot wound.

*Treatment.*—If it is possible to make a correct diagnosis concerning the nature of the injury, and it is decided that the liver has been involved, it will be found in nearly all cases to be imperative that the seat of the injury should be thoroughly examined, and any surgical treatment which is requisite should be at once carried out. This is especially the case when signs of internal hæmorrhage become manifest. The patient should be anæsthetised if his general condition will allow of this being done, and then the external wound is examined. If it is requisite to enlarge this, in order to make a complete examination of the injured tissues, it should be done at once. By this means the damaged organ is exposed, and the exact nature of the injury made out. If it is found that hæmorrhage is still going on, it must be arrested, either temporarily, by the application of sponge pressure over the bleeding area, or by packing the part with strips or plugs of aseptic absorbent gauze; or permanently, by the application of silk ligatures to the bleeding points, if they can be distinguished. All blood and clots are removed, so as to render a complete and uninterrupted view of the injured area possible. If any foreign body is met with, it must be at once removed. When the wound of the liver is a clean, incised, or punctured one, which does not extend to a very great depth, its margins and surfaces should be sponged as clean as possible with an aseptic solution, and the edges then brought into apposition and fixed by the introduction of a row of sutures of Chinese twist or of catgut. Each suture should enter the uninjured area of the liver, about one-third of an inch from the margin of the wound. It should then pass to the bottom of the wound through the liver substance, being brought out in a similar manner on the opposite side. A complete row of sutures about one-third or one-fourth of an inch apart is introduced, and then all are carefully tied and the ends cut short. Great care is requisite in tying the sutures, otherwise it will be found that they cut through the liver substance into the wound. A small amount of hæmorrhage usually follows from each point of puncture with the suture needle, but this soon ceases. When the entire row of sutures has been introduced and tied, the neighbouring parts of the peritoneal cavity and the abdominal wall are well sponged or irrigated, if requisite, so as to remove all traces of blood or foreign matter which may be present. The external wound in the abdominal wall is then closed with sutures. If there is much oozing of blood from the injured surfaces of the liver, it will be advisable to leave open a small part of the external wound. A drainage-tube may then be passed down to the region of the wound in the liver, or it may be packed with tampons of aseptic gauze, to be removed on the following day if the local conditions are favourable. A similar procedure should be carried out when much dirt has been introduced into the wound, either by the penetrating instrument or from any other cause. In most cases it will be found to be better and more convenient to make use of tampons of sterilised and aseptic gauze in place of drainage-tubes. This is especially the case when there is much oozing of blood from the injured tissues. In cases where there are signs of the commencement of septic peritonitis, it is advisable to irrigate the infected portion of the peritoneal cavity with an aseptic solution, and then to put in a drainage-tube, which can be removed at the end of twenty-four hours, if it is found that no further symptoms of septic infection develop. In gunshot wounds it is often difficult to decide which is the best method of treatment to adopt. The projectile which has been the cause of the injury cannot in all cases be found, whilst the wound extends to a considerable depth, and often involves or implicates adjacent viscera, the margins of the wound are frequently lacerated, and the surrounding parts of the hepatic substance are considerably contused. In every case where it can possibly be done, the projectile and any pieces of clothing which may have been introduced into the wound along with it, must be at once removed. The wound is then irrigated with an antiseptic solution, and packed with tampons of sterilised gauze. The strips of gauze are daily removed, the wound irrigated, and afterwards packed again with similar tampons. When all escape of fluid has ceased, and there is no danger of the occurrence of suppuration, the packing with gauze is discontinued, and, if it is considered necessary, a small drainage-tube is inserted, which should be gradually shortened, and finally removed altogether. Schlatter[1] has recently recorded the case of a man, æt. 25, who suffered from a stab of the abdomen which penetrated the liver, and was associated with prolapse of the transverse colon and the great omentum. Three and a half hours after the occurrence of the injury, the patient was anæsthetised, and the abdomen examined. After the prolapsed intestine and omentum had been replaced, it was found that hæmorrhage was taking place into the peritoneal cavity. The external wound was enlarged, when the liver was seen to be the seat of a penetrating wound from which the hæmorrhage was proceeding. The blood and clots were removed from the neighbourhood of the injured area, and then the wound in the liver was closed by the introduction of two catgut sutures, which passed to the bottom of the wound, and the superficial margins were afterwards approximated by the application of two silk sutures. The abdominal cavity was then thoroughly cleansed from all blood and other exudations, and the wound in the abdominal wall was closed by the application of a catgut suture to the parietal peritoneum, and tiers of sutures to the abdominal muscles and skin. Finally, an aseptic bandage was applied. The patient was said to have lost at least a litre of blood. The operation was followed by the complete recovery of

[1] Schlatter, *Beitr. z. klin. Chir.*, Tübingen, Bd. xv. s. 531 *et seq.*

the patient. Ruepp[1] operated upon a man who attempted to commit suicide by shooting himself with a revolver in the head and also in the epigastric region. The first bullet was found embedded in the skull, and was removed, no fracture of the cranial bones having occurred. The second bullet appeared to have passed into or through the left lobe of the liver, but its whereabouts could not be discovered. The left lobe of the liver was the seat of a star-shaped wound with irregular margins, from which a moderate amount of hæmorrhage was taking place. This wound was closed by the application of three deep catgut sutures, which arrested all hæmorrhage. After the peritoneal cavity had been freed from all blood and débris, the wound in the abdominal wall was closed in a similar manner to that mentioned above. A few days after the operation a small abscess formed in the abdominal wall, which necessitated the introduction of a small drain. The patient recovered, the ball remaining in some part of the posterior portion of the abdomen. Krönlein[2] also has had a similar case. The patient suffered from a gunshot wound of the abdomen, which caused injuries to the stomach, duodenum, pancreas, left kidney, and the liver. The wound in the liver was closed by the introduction of sutures, but the patient succumbed eight hours after the performance of the operation. In the case of lacerated wounds of the liver which are the result of perforation of the abdomen by some blunt body, the consequent shock and hæmorrhage usually prove rapidly fatal; but if the condition of the patient admit of an examination, the method of treatment which should be adopted is similar to that which has been recommended in the case of gunshot wounds.

*Complications.*—Injuries of the liver are frequently followed by the development of serious complications. One of the most common of these is the formation of an abscess. When this condition occurs it must be treated after the manner described when dealing with hepatic abscess. Peritonitis may also occur, especially in those cases in which the wound has been caused by a dirty instrument or by the projectile of a firearm. When met with it must be treated by incision of the abdominal wall, irrigation and subsequent drainage. Secondary hæmorrhage may come on some time after the reception of the injury, and is usually followed by a fatal termination. The only treatment which can be adopted is packing with tampons of aseptic gauze, since it is practically impossible in most cases to find the bleeding point. General hepatitis occasionally results from gunshot wounds, but this is uncommon, as in most cases of injury of this kind the inflammatory process tends to be localised to the track of the projectile. Jaundice is sometimes met with as a concomitant of general hepatitis, and rarely occurs when the inflammation is localised. Wounds of the liver, as we have already mentioned, are often associated with the occurrence of similar injuries to the ribs, spine, diaphragm, or the adjacent abdominal or thoracic viscera.

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[1] Ruepp, quoted by Schlatter, *q.v.*

[2] Krönlein, quoted by Schlatter, *q.v.*

*Prognosis.*—When the injuries to the liver are very severe, or they are associated with similar injuries to other abdominal viscera, the prognosis is usually very grave. In the case of severe incised wounds in which surgical treatment can be carried out soon after the infliction of the injury, it is probable that the future mortality will be much less than has been the case when the expectant treatment has been employed. Most cases of slight incised or punctured wounds which are submitted to early surgical treatment, ought to be followed by recovery, especially when no large blood vessel has been damaged. In the case of gunshot wounds, however, the prognosis and prospect of recovery is not so good. If the patient survive the dangers of shock and primary hæmorrhage, he is more liable to be the subject of the various complications which have been mentioned above than in the case of incised wounds. This is especially the case as regards the development of peritonitis and abscess. According to Otis,[1] twenty-five, out of a total of fifty-nine uncomplicated cases of gunshot wounds of the liver, recovered; whilst only thirty-seven, out of a total of one hundred and eleven complicated cases, were followed by a favourable termination. Lacerated wounds of the liver which are due to the penetration of a blunt body are in the majority of cases fatal, from shock and primary hæmorrhage. Mayer[2] has collected 267 cases of injuries of the liver, and has found that in ruptures the mortality was 86·6 per cent., in gunshot wounds 34·4 per cent., and in stabs 56·5 per cent. Edler[3] collected the statistics of 543 cases, and found the mortality to be, in ruptures 85·7 per cent., in gunshot wounds 55 per cent., and in stabs 64·6 per cent.

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[1] Otis, "Med. and Surg. Hist. War of Rebellion," Surg. vol.

[2] Mayer, *loc. cit.*

[3] Edler, *Arch. f. klin. Chir.*, Berlin, 1887, Bd. xxxiv., s. 173 *et seq.*

From these statistics it appears that gunshot wounds have been less frequently followed by a fatal result than either ruptures or stabs and incised wounds.

Terrier and Auvray[1] have recently collected the various cases of ruptures, perforating wounds, and foreign bodies in the liver, which have been published in surgical literature, and which have been submitted to direct surgical interference. They find that forty-six cases of this kind have been recorded. This number comprises eleven cases of rupture of the liver, which were due to direct or indirect violence, and were not associated with a perforating lesion of the abdominal or thoracic walls; one case of a foreign body in the liver; twenty cases of perforating wounds caused by sharp instruments; and fourteen cases in which a perforating wound was due to the projectiles of firearms.

Among the eleven cases of rupture, six of the patients recovered, and five died. In four of these cases the abdominal cavity was opened, and the injured viscus dealt with surgically, within twenty-four hours from the time of the occurrence of the injury; and in the remaining seven, surgical measures were not carried out until after the expiration of a longer period. It appeared probable that if the operation had been performed sooner, recovery might have followed in three of the fatal cases. In five of the cases, after the abdomen had been opened, the wound in the liver was packed with tampons of gauze; and in one of these, in addition, a pair of artery-forceps were left on a bleeding vessel for twenty-four hours. The wound was closed by the insertion of sutures in two cases, in three cases it was found impossible to discover the part of the liver which was the seat of the injury, whilst in one case the fluid was evacuated by a cannula. Death appeared to be due in the fatal cases either to the severity of the injury, or to the lateness of the operation, or to the inability of the operator to find the injured portion of the liver.

The percentage of recoveries was higher in the cases of incised and perforating wounds than in ruptures. Out of the twenty cases collected, fifteen recovered and five died. Concerning the time of operation, it is stated that in nineteen cases the operation was performed shortly after the occurrence of the injury, and in one case it was not done until some days afterwards, as an injury of the liver was not suspected in the first place. The operation was carried out through an abdominal incision in eighteen cases, and in two cases the thoracic wall was incised and portions of the ribs resected. Sutures were used to arrest the hæmorrhage ten times, tampons of gauze eight times, and the thermocautery in one case. The successful cases in most instances recovered quickly, but in one patient a biliary fistula became established which necessitated the performance of a second operation before complete recovery ensued. Of the five fatal cases, one died on the operation table; a second died from failure to arrest the hæmorrhage, on account of the portal vein being divided, and not discovered at the time of operation (the case of the President of the French Republic); the third died from hæmorrhage, owing to a portion of the rupture not being sutured; the fourth died from peritonitis and hæmorrhage; whilst the fifth case did not die until eight days afterwards.

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[1] Terrier et Auvray, "Les Traumatisms du Foie," *Rev. de chir.*, Paris, 1896, No. 10, pp. 718–775.

Fourteen cases of gunshot wounds of the liver have been treated by surgical operation. Ten of the patients recovered, and four died. Exploratory laparotomy was performed within twenty-four hours of the infliction of the injury in twelve cases, and in two cases the operation was not done until a longer period had elapsed. The cause of death in the fatal cases was, in one case, a wound of the pleura and right lung, the pleural cavity containing more than a litre of blood; in the second case, the stomach and colon were wounded and fæcal matter escaped into the peritoneum, and caused peritonitis; in the third case, there was a wound of the abdominal aorta; and in the fourth, several injuries of the stomach, intestine, pancreas, and kidney were also present. As regards the nature of the surgical procedures adopted, the wound in the liver was packed with tampons of gauze alone in three cases; and in two, in addition to the tampons of gauze, a glass drainage-tube was placed in the track of the projectile; in three cases it was closed by means of sutures; in one, the collection of blood and bile was evacuated through a simple incision; whilst in three cases all hæmorrhage was found to have ceased, and in these cases the region of the wound was disinfected with antiseptics. The projectile which had caused the injury was found in only two cases, in one lying free in the peritoneal cavity, and in the other embedded in the substance of the liver.

One case has been recorded of a foreign body in the liver. The patient was a child, æt. 5 months, who suffered from a biliary fistula situated in the right hypochondrium. This was due to a needle which had become embedded in the liver. A laparotomy was performed and the needle extracted. The patient recovered.

# CHAPTER XV.

## TUMOURS OF THE LIVER.

The liver is very frequently the seat of tumours, but in most instances it is found that these tumours are secondary formations which are dependent upon the presence of a primary growth in some other part of the body, small particles of the tumour having been carried to the liver by the portal vein or by the branches of the hepatic artery. In a small number of cases, the tumours of the liver are primary in character, and usually of a malignant type. Innocent tumours of the liver are met with, but they are not common. The variety which occurs most frequently is some form of angioma; but fibromata, fibro-neuromata, and simple adenomata have been described, and cases recorded in surgical literature.

*Angioma.*—An angioma of the liver is a localised tumour of a non-malignant type, which, as regards its origin, may be either congenital, or it may develop in the later periods of life. Several distinct varieties of this affection have been described. The most common variety has the form of a localised tumour, somewhat variable in size, and situated immediately underneath the capsule of Glisson. It consists of a number of dilated blood vessels, which have the appearance and structure of ordinary cavernous tissue, and which, according to Virchow, are in direct connection with the smaller branches of the hepatic artery, from which they can be injected; but Rokitansky and Frerichs deny this, and say that they only have communications with the veins. It has also been maintained that these tumours are developed in connection with an accessory spleen and its accompanying artery, owing to an adhesion being established between the surface of the liver and this accessory organ. The evidence upon which this theory is based appears, however, to be very inconclusive. In some cases of angioma of the liver, the cavernous tissue which constitutes the tumour may be destitute of a capsule, and lie in close relation with the adjacent hepatic tissue; or it may have a distinct capsule, consisting of rather dense fibrous tissue, in which case the tumour is called an encapsuled or encysted angioma. After a tumour of this kind has been formed, the cavernous tissue may be replaced to a considerable extent by fibrous tissue, in which case it is known as a fibrous angioma. It occasionally happens that, in connection with an angiomatous tumour, a large quantity of melanin is deposited in the cells which line the blood spaces, and in the surrounding cellular tissue, and when this occurs the growth assumes a dark pigmented appearance, and is then described as a melanotic angioma. If the blood vessels which supply the tumour with blood become obstructed, so as to prevent a continuous stream of blood passing to the cavernous spaces within the tumour, the blood which normally occupies these spaces may become absorbed, and the spaces filled with a serous fluid, in which case the tumour is called a cystic angioma, or an angioma which has undergone cystic degeneration. The direct pathological cause which gives rise to the development of this variety of tumour does not appear to be very clear. In those cases which first appear in the later periods of life it has been suggested that localised inflammatory conditions of the interstitial tissue of the liver around the intra-hepatic branches of the portal vein may be concerned in their origin. It has also been maintained that the condition is associated with an atrophy of the liver cells in the interior of an acinus of the gland.

*Symptoms.*—Those angiomata which are of congenital origin usually grow quickly and increase in size so as to cause the development of a large tumour in connection with the liver, which may give rise to the appearance of a large abdominal swelling extending downwards as far as the umbilicus. Children who are afflicted with this variety of tumour generally die at an early age; of two recorded cases of this kind, one patient succumbed at the age of 8 months, and the other at the age of 6 months. Those cases which commence in later life, and may be spoken of as "acquired cases," occur more commonly in the male sex, and are usually met with in people who are over 60 years of age. They are very rarely seen before the age of 40. In most cases these tumours remain small and do not attain large dimensions. They may be single or multiple, often the latter, as many as thirty or more having been met with in the same patient. Each tumour is most commonly rounded in outline, and it is separated from the surrounding liver tissue by a layer of fibrous tissue, which is derived from the interstitial substance of the gland. Usually these tumours project upon the superficial surface of the affected viscus, and they are found most frequently in the region of the antero-inferior margin or near the suspensory ligament, but occasionally they have been met with in the interior of the organ. Tumours of this kind are rarely larger than a walnut in size. They do not give rise to any symptoms by which their presence can be suspected during life; so that in nearly all cases they have only been discovered post-mortem.

*Treatment.*—Owing to the absence of symptoms, and to the innocent nature of the tumour in those cases which are of acquired origin, surgical treatment is not called for. When the tumour grows and attains a large size, as in the cases which occur in young children, and are of congenital origin, surgery does not afford any efficient method of treatment which offers a possibility of a cure. If a tumour of this kind is met with, it may be possible in those cases in which the swelling has not attained a very large size, to open the abdominal cavity and attempt to deal with it by applying a ligature to its base or to the pedicle, if one exists. In the majority of cases it is not advisable to attempt the local removal of the tumour, on account of the very severe hæmorrhage which would be certain to occur; but if it is found possible to encircle the affected portion of the liver with an elastic ligature, and so control the passage of the blood along the blood vessel supplying the tumour, it may be practicable in such cases to effect a complete removal of the affected portion of the gland.

Eiselberg[1] has recently recorded a unique case of cavernous angioma of the liver which he submitted to operation. The tumour was attached to the right lobe of the gland, and when it had been removed it weighed 470 grms. In the early part of the operation for the removal of the tumour, after the abdominal cavity had been opened, an incision was made in its base, but such severe hæmorrhage resulted that it was necessary to press the tumour back into its original position, and to carry the incision through healthy liver tissue beyond the margins of the growth. The thermocautery was used to effect the separation of the tumour from the liver. When a vessel was divided and blood exuded from the cut end, it was ligatured at once with silk; by this means the hæmorrhage was well controlled. When the tumour had been separated, the margins of the wound in the liver were brought into apposition and fixed by the insertion of a number of silk sutures. When this had been done, the parenchymatous hæmorrhage from the incised surfaces of the gland immediately ceased. The region of the wound in the liver was packed with tampons of iodoform gauze, the ends of which were allowed to protrude from an angle of the parietal wound which was left open for the purpose. The remaining part of the external wound was closed with sutures in the usual manner. The patient recovered completely, and at the expiration of seven weeks left the Hospital.

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[1] Eiselberg, *Wien. klin. Wchnschr.*, 1893, No. 1.

Rosenthal[1] operated upon a case of fibrous angioma of the liver, the tumour being of the size of a child's head, and situated in the region of the lobulus Spigelii. The tumour was somewhat pedunculated, so that it was possible to pass an elastic ligature around the pedicle close to its attachment to the liver. This elastic ligature was held in position by a steel needle, and the tumour was excised, only slight hæmorrhage being encountered during the performance of the operation. Five days later, when the ligature had commenced to ulcerate through the pedicle, that portion of the pedicle which lay distal to the ligature was cut through with the thermocautery. When this had been done, the entire wound in the liver was packed with tampons of iodoform gauze, and the parietal wound closed. At the end of six weeks the patient had completely recovered.

In those cases in which the tumour has attained a large size, the only possible method of treatment appears to be that by electrolysis; but this does not seem to offer much chance of cure, judging by the results which have been obtained by this method of treatment in other regions of the body.

*Fibromata.*—Fibromata and neuro-fibromata of the liver are exceedingly uncommon, and have only been met with very rarely. Pisenta has described a case of multiple fibromata of the liver.

*Adenomata.*—Adenomata of the liver, occurring in glands which are otherwise normal, and also in cirrhotic livers, have occasionally been met with and described, but their occurrence is very uncommon. When present they do not always give rise to the development of symptoms by which their presence can be recognised. It is possible that epithelial growths of this kind may be the precursors of the formation of primary malignant tumours of the liver.

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[1] Rosenthal, *Gaz. lek.*, Warszawa, 1893, No. 45 (quoted by Kousnetzoff and Pensky).

Groube[1] of Kharkov has operated upon a man who was said to be suffering from an adenoma of the liver. The patient was a man æt. 55. He gave a history of having had a swelling in the epigastric region for twenty years. Fifteen years after the first appearance of the abdominal swelling, severe pains in the region of the tumour compelled the patient to seek medical advice. He was sent to Carlsbad, and underwent the "cure" there. The pains disappeared, but the volume of the tumour remained unaltered. Six months before the patient came under the care of Groube, he was injured in the hepatic region by the pole of a carriage. After this accident, pains in the region of the abdominal swelling were severe and constant, whilst the patient became emaciated. When seen by Groube, the patient had a large tumour in the epigastric region, which was firmly fixed to the liver and apparently embedded in it. An operation was resolved upon, and the surface of the tumour exposed by making an incision through the overlying portion of the abdominal parietes. Numerous peritoneal adhesions were met with, and when the surface of the swelling had been laid bare, the tumour was found to be embedded in normal liver tissue, whilst it had a distinct capsule which had become calcified. The tumour was removed, and the cavity in the liver which was left was packed with tampons of iodoform gauze, and the parietal wound closed, except for a small part where the ends of the strips of gauze were brought out. On the fifth day the packing of gauze was removed for the first time. At each succeeding change of the dressing, 5 to 10 grms. of a solution of pyoctanin (1 in 500) was injected into the wound in the liver. This injection was repeated six times in all. One month after the operation the patient was discharged from the Hospital. He was free from pain and had gained in weight, but a small fistula in the epigastric region still remained. Six months afterwards the patient was seen, and was then apparently quite well; but eleven months after the operation he returned to the Hospital, and was found to be suffering from cancer of the liver.

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[1] Groube, quoted by Kousnetzoff and Pensky, *Rev. de chir.*, Paris, 1896, No. 10, pp. 512-514.

The structure of the tumour was said to be a tubular adenoma. Groube assumes that in this patient a non-malignant adenoma of the liver had existed for twenty years, and that at the end of this time the swelling acquired malignant characters, and ultimately caused the death of the patient.

Bergmann[1] has recorded a similar case. The tumour was fixed to the left lobe of the liver. In the removal of the tumour severe hæmorrhage was experienced, but this was arrested by the application of ligatures to distinct bleeding points, cauterisation of the incised surfaces with the thermo-cautery, and packing of the entire wound with strips of iodoform gauze. The patient recovered from the operation, and at the end of six weeks was quite well.

*Malignant neoplasms of the liver.*—Primary tumours of the liver, which commence in the hepatic epithelium and are malignant in character, occur in three different forms, which depend upon the mode of growth of the epithelial elements. In the first variety, the carcinomatous process commences at one focus within the organ, and gives rise to the formation of a large tumour, which may ultimately involve a considerable portion of the gland. In most cases of this kind, the right lobe is the situation of the early development of the growth. Instead of the disease commencing at one point, there may be several foci. In the later stages of this variety, the interior of the large mass of cancer may disintegrate and break down, and hæmorrhage take place into its interior. Numerous secondary growths are also frequent in the later stages of the disease. In the second variety, the pathological process is characterised by the development of an excess of fibrous tissue in connection with the epithelial elements. The liver in these cases resembles in many respects the liver in alcoholic cirrhosis, and the affection has been called cancer with cirrhosis, or cancerous cirrhosis. This form of the disease may occur in the course of ordinary cirrhosis of the liver, owing to the epithelial cells of the gland taking on or assuming an atypical form of growth, which results in the development of cancer; or the cancerous condition may first commence and be associated with the formation of a considerable amount of fibrous tissue, which gives rise to the appearance of cirrhosis. The former mode of origin of this variety of cancer of the liver seems to occur most commonly. In the third variety of cancer of the liver, the tissue which surrounds the branches of the portal vein in the substance of the organ is the seat where the disease first becomes apparent. This is due to the fact that in these cases the pathological process commences in an atypical growth of the epithelial cells which line the interior of the intra-hepatic bile ducts accompanying the branches of the portal vein. In the earlier stages of this form of cancer, multiple foci of new growths are in most cases found to develop along the course of the branches of the portal vein within the liver, and as the disease progresses many of these may approach one another so closely as apparently to fuse and thus form large masses of new growth. Carcinomata of the liver may be divided into two classes, according to their seat of origin. The first class comprises those cases in which the cancerous process commences in the cellular elements which normally occupy the interior of the hepatic trabeculæ, and the second class those which have their origin in the epithelial cells of the intra-hepatic bile ducts. In the first class, the affection is an adeno-carcinoma, and the cancer cells have the structure and appearance of cylinder cells; whilst in the second class the growth is a true carcinoma, which is either of the nature of an ordinary cancer, with a moderate amount of fibrous tissue elements, or the epithelial cells form the greater part of the tumour, and cause it to have the appearances of a medullary carcinoma, and the cancer cells have the form and shape of large epithelial cells, occurring as solid cell nests. Primary carcinomata of the liver, which have their origin in the epithelium of the intra-hepatic bile ducts, appear to be more commonly met with than those growths which commence in the hepatic cells within the liver trabeculae.

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[1] Bergmann, *Arch. f. klin. Chir.*, Berlin, 1893, Bd. xlvi. s. 383.

Sarcomata of the liver which are primary in character are very rare, and have only been recorded by a few observers. Podrouzek,[1] writing in 1888, says that up to that time he had only been able to find the records of thirteen cases of primary sarcoma of the liver, and of these it was doubtful whether all were cases of true primary sarcoma, and to this list he adds a personal observation of a case of primary spindle-celled sarcoma. Hans Kehr has recently recorded a case of sarcoma occuring in a girl of 15. The primary sarcomata of the liver which have been described comprise cases of angio-sarcoma, melanotic sarcoma, and ordinary round and spindle-celled growths. It is possible that those growths which were melanotic in character, were secondary to a primary focus of disease which was not discovered at the time of the post-mortem examination.

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[1] Podrouzek, *Prag. med. Wchnschr.*, 1888, Nos. 32 and 33.

The liver is very frequently the seat of metastatic malignant growths. The primary growths may be either carcinomata or sarcomata. They develop most commonly after carcinoma of the abdominal alimentary canal, of the uterus, the pancreas, the mammary gland, and the pelvic viscera; and after all varieties of sarcoma, especially the melanotic forms and those which affect the region of the abdomen or one of the long bones. Carcinomata of the gall bladder and the biliary ducts may by direct extension involve the adjacent portions of the liver, or less commonly they may be the cause of the development of secondary growths. As an explanation of the great frequency of secondary growths in the liver, after malignant disease of the abdominal viscera, it appears to have been conclusively proved that it is due to the fact that small particles of the primary growth pass into one of the radicles of the portal

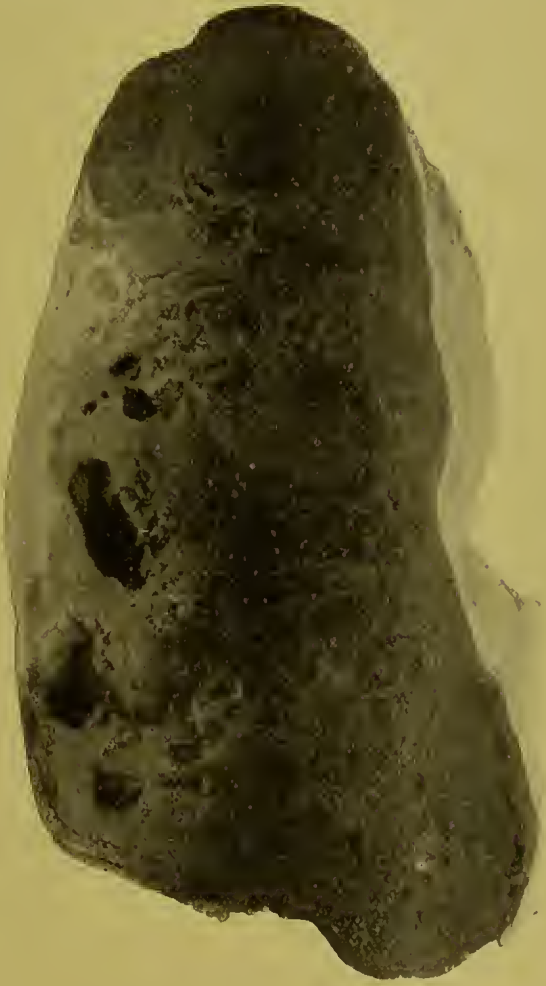

FIG. 24.—Sarcoma of the liver (primary). A portion of the right lobe of the liver, of a child, æt. 3. The cut surface shows that scarcely any traces of liver tissue remain, the entire organ being infiltrated with a soft disintegrating sarcomatous growth, in which cavities of various sizes have been formed. The organ was irregularly lobulated in all directions from the presence of numerous globular growths from 1 to 2 inches in diameter. The liver weighed a little over 4 lbs. The growth was a small round-celled sarcoma. No secondary deposits were found in other viscera.—*St. Barth. Hosp. Museum.*

vein which is involved in the disease, and by this vessel are carried to the liver, where they are arrested in the portal capillaries and become a commencement of a secondary focus of disease.

Primary carcinoma of the liver is, as we have already seen, rare, and when it occurs it involves either a part or the whole of the organ in a malignant infiltration, which manifests itself by causing the development of a general or more often of a localised solid enlargement of the liver. When the disease is secondary, the enlargements are most commonly multiple, and they then give rise to the formation of swellings, which can be felt as tumours upon the external surface of the liver when the hepatic region is palpated through the abdominal wall. In certain cases these swellings have a soft and elastic feel, which suggests the presence of fluid. This is due to the occurrence of a process of disintegration and breaking down in the interior of the

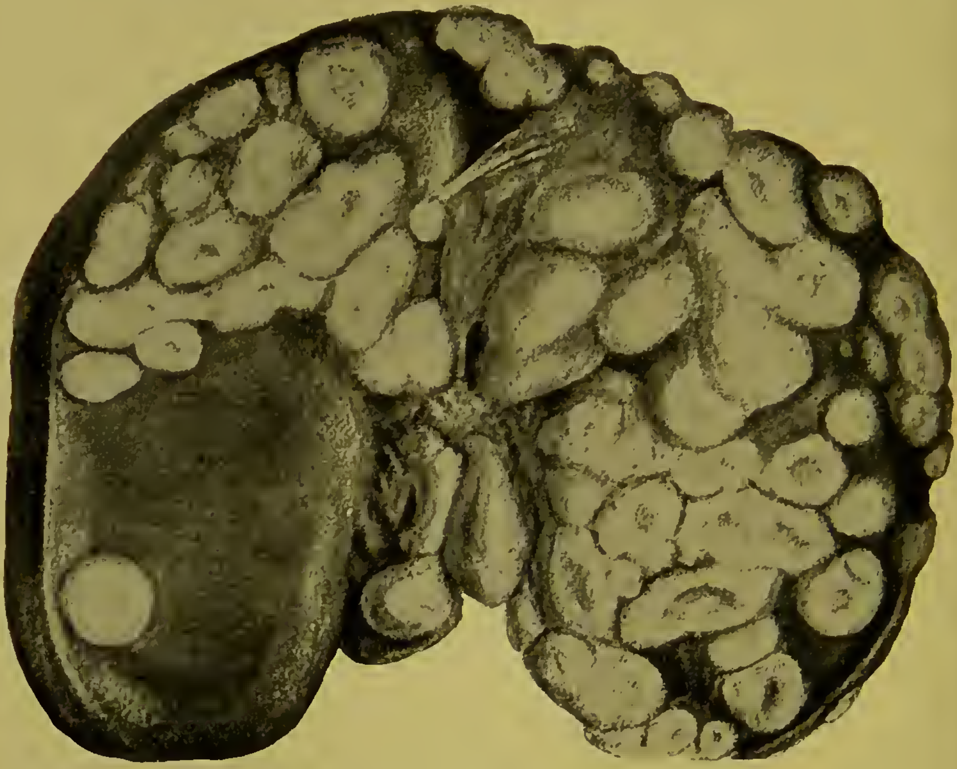

Fig. 25.—Sarcoma of the liver (secondary). The liver of a boy æt. 10, enormously enlarged and studded with large nodules, presenting all the appearances characteristic of secondary deposits. The growth is a sarcoma secondary to a growth of the kidney.—*St. Barth. Hosp. Museum.*

tumour, and the consequent formation of spaces which contain blood and carcinomatous or sarcomatous débris.

*Symptoms.*—The formation of a malignant growth in the liver is usually preceded by the occurrence of lancinating pains in the hepatic region, especially in the right hypochondrium, and associated with the appearance of signs of wasting and loss of flesh. In a considerable number of cases it is possible to find evidence of a primary focus of disease in some part of the body, especially in one of the abdominal viscera, or in one of the long bones. Sarcomata of the umbilicus, in nearly every case, except during the earliest stages of the affection, are accompanied by the development of secondary growths in the liver. In a case of this kind which recently came under my observation, I found that although the primary growth was small and localised, and easily capable of removal, it was associated with numerous secondary growths on the inferior aspect of the liver, which could not be felt through the anterior abdominal wall. Enlargement of the liver occurs in all cases, but in those in which the malignant process is associated with the condition of cirrhosis,

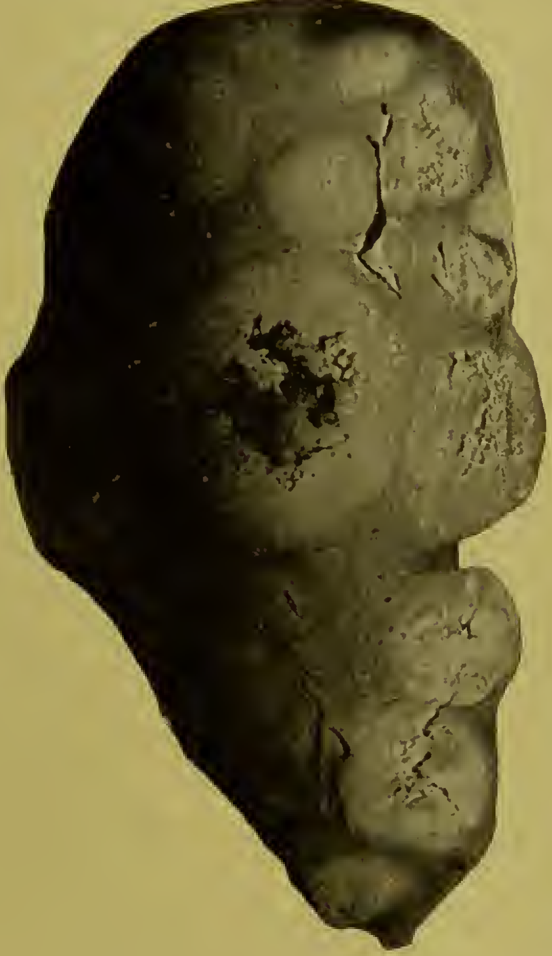

FIG. 26.—Carcinoma of the liver (secondary). The section of a liver containing secondary growths, following a primary carcinoma of the rectum. The substance of the liver is occupied by numerous cancerous deposits of varying size. The largest in the centre of the specimen shows degeneration in the deeper parts, the softened matter having fallen out, leaving a ragged cavity. Other nodules similarly, but to a less degree, show the central softening and breaking down. The surface of the liver is nodular.—*St. Barth. Hosp. Museum.*

it does not become manifest until a much later stage of the disease. The enlargement may cause the organ to extend downwards into the abdomen for a variable distance below the costal margin, or upwards so as to encroach upon the space which is normally occupied by the lungs, especially the right, and in many cases it is found that an enlargement has taken place in both directions. This enlargement may exist for some time and attain considerable dimensions before it gives rise to the appearance of symptoms from the occurrence of which the existence of the disease can be diagnosed. As a result of enlargement of the liver, an abdominal tumour becomes manifest, and in those cases in which the foci of disease are multiple this tumour will have an irregular outline, and its surface present several bossed projections which are apparent on palpation. In most cases the tumour moves with the respiratory movements, and it is dull on percussion. In the later stages of the disease the tumour may occupy the greater portion of the cavity of the abdomen, and in this condition it is not always possible to detect that the tumour moves synchronously with the respiratory movements. Disturbances of the digestive processes are constantly present, and the appetite is very poor. In the general diffuse form of primary cancer of the liver the patient is anæmic and the skin pale, but in the later stages there may be jaundice, although this is not of constant occurrence. In the nodular variety, jaundice is often present in the early stages of the disease, and after its appearance it gradually deepens in intensity and persists until death. Ascites may be a prominent symptom, and may be due, either to pressure upon the portal vein as it lies in the portal fissure or in the gastrohepatic omentum, or to the irritation which is caused by the extension of the cancerous growth to the peritoneum and the development of cancerous peritonitis. Pressure of the growth upon the common bile duct may cause an accumulation of bile in the gall bladder, and the appearance of a tumour which is dependent upon the distension of this viscus. In rare cases the inferior vena cava may be pressed upon by a growth, and phlebitis and thrombosis of this vessel induced. Recently, I saw a case in which a secondary growth in the lobulus Spigelii caused thrombosis of the adjacent portion of the inferior vena cava and complete obliteration of its lumen. Progressive emaciation is an invariable symptom of hepatic cancer, and it becomes especially manifest in the later stages of the affection. Malignant disease of the liver may be met with in persons of almost all ages, but, in those cases in which the affection is primary, adults over 40 are chiefly the subjects of the disease. When, however, the affection is sarcomatous in nature, young people and even children may be affected. In those cases in which secondary centres develop in the liver, it is found that sarcomata occur chiefly in young persons, and that carcinomata are for the most part met with in adults.

*Diagnosis.*—Primary neoplasms of the liver, as we have already seen, are not very common, and when they are met with their diagnosis is often somewhat difficult. When a patient is found to be suffering from a tumour which is situated in the upper portion of the abdomen, and connected with the liver itself, and this tumour moves with respiration, and on palpation appears to be solid in consistency, the possibility of the existence of a malignant disease of the liver must be taken into consideration. In all cases of this kind a careful search must be instituted for the presence of a primary focus of disease elsewhere: thus, a rectal examination should be made so as to determine the condition of the rectum and the other pelvic viscera; and at the same time the abdomen should be examined, an anæsthetic being administered if requisite. Echinococcus cysts, abscess of the liver, amyloid disease, and tertiary syphilitic affections may be mistaken for cancer of the liver. These pathological conditions can usually be excluded by paying careful attention to the signs and symptoms which are present. In cancer of the liver the organ is enlarged, the surface is irregular, and presents several localised elevations which are hard in consistency and do not give any evidence of the existence of fluid; icterus is frequently met with, ascites is usual in the later stages, pain is a constant symptom, and enlargement of the spleen is in all uncomplicated cases absent. In all cases of malignant disease, especially those which involve the pelvic or abdominal viscera, or the bones of the extremities, an examination of the liver and hepatic region should be made before an operation is performed for the removal of the primary growth, in order to exclude the possibility of the occurrence of secondary deposits in the liver. It occasionally happens in cases of sarcomatous disease of the bones, especially those of the lower extremities, that secondary growths develop in the liver at a very early stage of the affection. In those cases in which an exact diagnosis is impossible, and in which a tumour of the abdomen exists and is perhaps in connection with the liver, it is justifiable to perform an exploratory laparotomy, so as to make clear the nature of the affection, and then to proceed according to the conditions which are discovered after the abdomen has been opened.

*Treatment.*—Whenever multiple nodular cancerous growths of the liver have been definitely diagnosed, it may be said that there is no surgical procedure available which will arrest the progress of the disease, and at the same time save the life of the patient. If, however, the cancerous affection is primary in the liver, is limited to a small portion of the gland, and there are no secondary deposits elsewhere, it appears to be within the province of surgery to attempt its extirpation, and this method of treatment has the support of a number of eminent surgeons. The removal of the growth can be effected according to one of the methods which are described in the chapter dealing with resection of the liver, or partial hepatectomy. Keen of Philadelphia has successfully removed a large malignant adenoma of the liver, and many other surgeons (Langenbuch, von Bardeleben, Israel, Lins, Groube, von Bergmann, Tricomi, Lücke, Müller, Schmidt, and Mayo Robson) have removed similar tumours, and in most instances successfully. Hans Kehr, Slifossowsky, Israel, and Bardeleben have also successfully removed sarcomatous growths from the liver. Hochenegg has described a case in which Albert removed a portion of the right lobe of the liver, together with the gall bladder which was the seat of a carcinomatous growth, and the patient recovered from the operation. Hæmorrhage from the liver tissue appears to be the chief danger in the performance of these operations, but if careful precautions are taken for its prevention it seems to be possible to avoid trouble from this source. When large veins in the interior of the liver are divided, air is liable to be drawn into them and carried to the heart by the inferior vena cava, and thence to the lungs, where it may cause embolism. This must be avoided by continuous pressure upon cut surfaces of the liver, and immediate ligature of all bleeding points. In those cases in which it is found to be impossible to approximate the cut surfaces of the organ, the margins of the wound in the liver should be united to those of the wound in the abdominal wall with silk sutures, and the wound itself packed with strips or tampons of aseptic gauze, so as to prevent the occurrence of hæmorrhage or embolism. An attempt to remove a malignant growth of the liver should only be made when the affection is strictly circumscribed and does not involve a large portion of the organ, and when it is not associated with the development of secondary growths elsewhere. Whenever the liver is the seat of multiple malignant growths, no attempt should be made to effect their removal.

*Prognosis.*—The prognosis in all cases of malignant affections of the liver is distinctly bad. The dangers of the actual operations which have been carried out for their removal do not appear to be so serious as has generally been imagined. The hæmorrhage can, in almost all cases, be controlled by passing an elastic ligature around the base of the affected portion of the gland, and by applying sponge pressure upon the incised tissues. Hæmorrhage usually ceases when the incised surfaces have been approximated and fixed in this position by the insertion of silk sutures. In the removal of portions of livers from animals experimentally, I have had no difficulty from hæmorrhage, but it is easier to control the circulation in animals than in man. Some authors have recommended the use of Paquelin's cautery when the hæmorrhage has been severe. It is better, however, to avoid the use of this means for the arrest of hæmorrhage, since the cauterised surface must separate later, and healing is delayed and the occurrence of suppuration is favoured. Most of the cases which have been operated upon have succumbed later, from a recurrence of the disease. In Lücke's case the patient was well five years later, but generally recurrence has occurred within a few months of the performance of the operation. In Hans Kehr's case of sarcoma, the patient, a girl æt. 15, died a few weeks afterwards from a recurrence. In Hochenegg's case the patient was quite well three years afterwards.

# CHAPTER XVI.

## PENETRATING WOUNDS OF THE GALL BLADDER AND BILIARY DUCTS.

Penetrating wounds of the gall bladder or of the biliary ducts rarely come under the cognisance of the civil surgeon, since their occurrence is very infrequent, owing to the small size of the structures themselves, and to their protected position behind the lower ribs and costal cartilages. These injuries are more frequently met with by military surgeons in times of war, on account of the large number of perforating wounds of the abdomen and thorax which then require treatment. This class of injury is met with as the result of the following varieties of mechanical violence, namely, (*a*) stabs or penetrating wounds, inflicted with sharp instruments, which involve the upper portion of the abdomen or the lower part of the thoracic region, especially when they are situated in the right hypochondriac region of the abdomen. When met with, these wounds are generally found to have been made with a homicidal intent, or to occur in military practice in the form of bayonet wounds. (*b*) Gunshot wounds of the gall bladder or biliary ducts are in nearly all cases associated with similar injuries of other of the abdominal or thoracic viscera. The gall bladder is the organ which is usually involved, but the hepatic ducts have in a number of cases been found to have been divided as the result of gunshot wounds. Courvoisier[1] has collected fourteen cases of penetrating wounds of the biliary passages, six of which were caused by the projectiles of firearms, and eight by sharp instruments. Kehr[2] has also reported a case of revolver wound of the gall bladder, and Dalton[3] one in which the gall bladder was perforated by a stab. Bell, Paroisse, Poland, Sabatier, Stewart, and Watson have recorded cases of this kind, all except one of which ultimately proved fatal.

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[1] Courvoisier, *op. cit.*

[2] Kehr, *Centralbl. f. Chir.*, Leipzig, 1892, s. 645.

[3] Dalton, *Am. Journ. Med. Sc.*, Phila., 1890, p. 708.

*Symptoms.*—In all cases of injury of this kind a perforating wound of the external surface of the trunk is seen, generally in some part of the upper abdominal or lower thoracic area, especially in the right hypochondriac region, which has been inflicted with a sharp instrument, or by a gunshot missile, which has passed inwards towards the gall bladder or portal fissure of the liver, and from this wound blood, bile, or blood and bile-stained fluid often exude. Considerable abdominal pain and tenderness, which is at first usually localised to the right hypochondriac region, is present, and is associated with symptoms

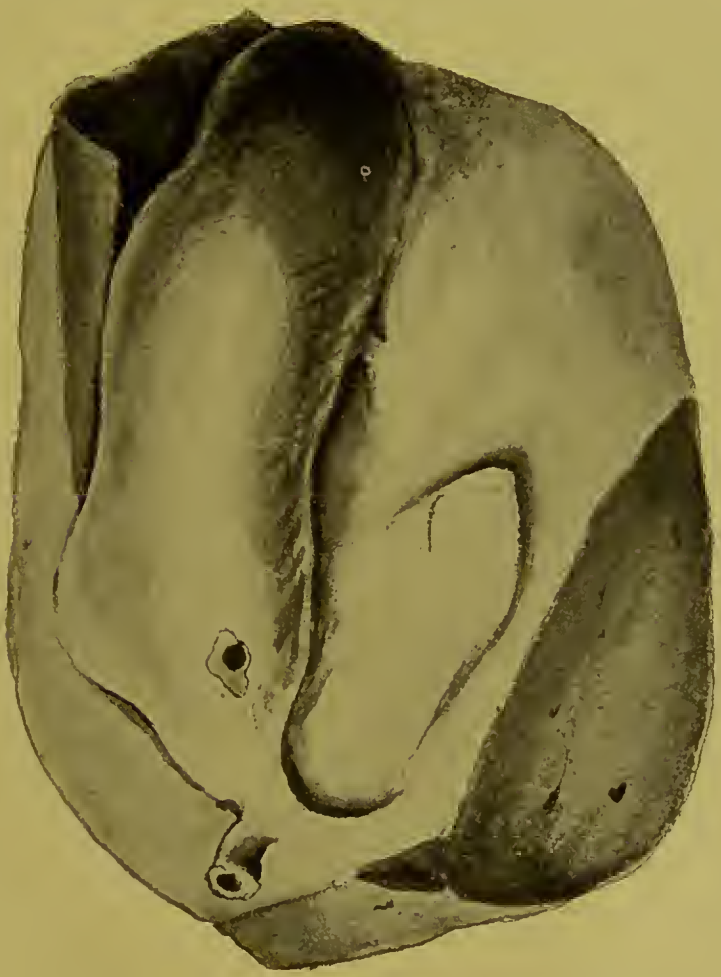

FIG. 27.—Gall bladder, with a punctured wound near the neck, which was caused by a pitchfork. The patient died five days later from peritonitis.—*St. Barth. Hosp. Museum.*

of shock and collapse; the pulse is feeble, small, frequent, and possibly intermittent; the respiration is laboured; whilst the face is pale and pinched, and the patient has an anxious expression. There may be in addition nausea and vomiting; the limbs are cold, owing to the weakening of the expulsive power of the heart, and consequent slowing of the circulation of the blood; and the patient is very uneasy and restless; in fact, there are all the signs of a commencement of an attack of acute peritonitis, combined with which are the symptoms of shock, which has developed as the result of the mechanical injury to the abdominal viscera, and those which are due to the passage of an irritating fluid into the peritoneum. Jaundice may occur as a symptom in these cases, but it is not common, and when it is met with it is usually slight in amount, whilst bile is found in the urine a short time after the contents of the gall bladder or the bile ducts have been absorbed and passed into the blood stream, either from the peritoneum, or by any other route. A short time after the reception of the injury the abdomen becomes swollen and tense in those cases in which the bile passes into the peritoneal cavity, and on this account many of the localising symptoms which would otherwise help to elucidate the pathological condition are masked. The shock may be so severe as to cause unconsciousness, and when the patient recovers from this condition intense pain and tenderness in the hypochondriac region, or in the abdomen generally, are complained of.

*Diagnosis.*—When a patient is suffering from a penetrating wound of the abdominal parietes, from which bile or a mixture of bile and blood issues, and the infliction of the wound is immediately followed by the development of great pain and tenderness in the right hypochondriac region, it is exceedingly probable that the gall bladder or one of the larger bile ducts has been injured. A careful examination of a penetrating wound of the abdominal wall by means of a blunt-pointed probe, will help in establishing a correct diagnosis. Much care, however, must be taken in making this examination, since it is possible to cause further injury to the peritoneum or abdominal viscera by a prolonged instrumental investigation of this kind. In those cases in which signs of peritonitis as a result of an injury become evident, without the development of any special localising symptoms, it is necessary to perform an exploratory laparotomy before any complete diagnosis can be made.

*Treatment.*—All injuries of the gall bladder or of the biliary ducts, which are due to perforating wounds of the abdominal wall, require immediate surgical treatment in order to ensure to the patient the greatest chance of recovery. If the symptoms which follow the infliction of the injury are sufficient to enable the surgeon to make a diagnosis that the gall bladder, or one of the bile ducts, is the seat of injury, an examination of the abdomen, either through an enlargement of the wound of the abdominal wall, especially when this wound is located in the right hypochondriac region, or through an incision in the right linea semilunaris, or in the linea alba, should be made, and the exact nature of the damage made out. In most cases it will be found advisable to make the incision through the abdominal wall in the right linea semilunaris, since it has been found in nearly all cases of this injury that the gall bladder, or the cystic duct, has been the portion of the biliary system which has been damaged. If the gall bladder is found to have been injured, and the perforation is seen to be small, and not to extend through the posterior wall of the sac into the adjacent portion of the liver, then the aperture should be closed by the insertion of a row of fine silk sutures applied by Lembert's method. If the wall of the gall bladder is thick enough, it is better first to close the aperture of perforation by the application of a continuous suture, which transfixes the mucous coat only, and then to complete the operation as above. In most cases of this kind it will be found that the wall of the gall bladder is too thin to allow this to be done. Afterwards the abdomen is thoroughly cleansed from any bile or other fluid which may have exuded, the sutured gall bladder is dropped back into the abdominal cavity, and the wound of the parietes closed with tiers of interrupted sutures. When the wound in the gall bladder is found to be a large one, and to be situated in the neighbourhood of the fundus, the aperture should be closed in a manner similar to the one described above, but after this has been done the wounded part of the viscus must be fixed to the deep portion of the parietal wound; the external incision is then closed, except for a small part where a drain is inserted, which will allow the detection of any leakage of bile, if this should occur. If the wound of the gall bladder be very large and involve that portion of the sac which is adjacent to the cystic duct, removal of the gall bladder by the performance of cholecystectomy must be effected without delay. If the cystic duct is found to have been divided, the ends must be closed with silk sutures, and then the gall bladder is to be removed. If the common bile duct, or one of the hepatic ducts, is divided, the same method of treatment is to be carried out as has been advised in cases of rupture of the same structures. Thus, if the common bile duct is divided, the two ends are ligatured and a cholecystenterostomy performed, whilst, if the hepatic ducts are the seat of injury, the divided ends are ligatured, in order that adhesions may be formed and the biliary passage re-established. If the common bile duct is only partially divided, an attempt may be made to close the aperture by the application of a row of fine silk sutures. After the local injury has been treated by one of the above methods, the adjacent portion of the peritoneum and the abdominal cavity is thoroughly cleansed by washing with sterilised water, so as to remove all traces of blood, bile, and débris, and then the abdominal wound is closed. If the gall bladder or the biliary ducts are found to be the seat of an inflammatory affection, and to contain purulent material, the wound of the gall bladder should always be stitched to the abdominal wall, so as to create a fistula, and into this a drainage-tube is inserted.

*Prognosis.*—If the affection can be diagnosed at an early stage before extensive peritonitis has been established, and if appropriate surgical treatment be at once carried out, the patient will stand a fair chance of recovery, especially in those cases in which the gall bladder or the cystic duct is the seat of the injury. When the common bile duct or one of the hepatic ducts is divided, the prognosis is much worse than when the gall bladder or the cystic duct is damaged. If acute peritonitis has been established, owing to the escape of septic matter into the peritoneum, the prognosis is very serious, although, when the results which have followed incision, washing out, and drainage of the peritoneum in acute cases of septic peritonitis are taken into consideration, it seems probable that the results in this class of case will be much better in the future than they have been in the past.

The cases of Kehr and Dalton were operated upon immediately after the reception of the injury. In each instance a wound of the gall bladder was found, which was closed by sutures, after the damaged viscus had been exposed by laparotomy.

# CHAPTER XVII.

## RUPTURE AND PERFORATION OF THE GALL BLADDER OR BILE DUCTS.

Rupture of the gall bladder or bile ducts, which is not associated with or due to the occurrence of a perforating wound of the abdominal or thoracic parietes, may be caused by a blow or kick over the hepatic region, or by severe crushing of the abdomen, such as when the wheel of a heavy vehicle passes over the hepatic region, or by a fall from a considerable height, the patient alighting either upon his feet or some other part of his body. If the gall bladder is distended with bile, owing to the presence of a calculus in the neck of the viscus or in the cystic duct, at the time of the reception of the injury, a rupture of the organ is much more likely to occur. Rupture of the gall bladder or one of the bile ducts is, however, an uncommon condition as a result of abdominal injuries, and an examination of the clinical records of St. Bartholomew's Hospital reveals only a few examples. In one case of this kind a rupture of the sac, close to its attachment to the liver, followed a kick in the hepatic region; and in another case a rupture of the fundus of the gall bladder resulted from a fall against a log of timber. If the gall bladder or the bile ducts are occupied by numerous or large calculi, traumatism applied to the hepatic region may produce rupture of the gall bladder or bile ducts, which is followed by the passage of bile and calculi into the adjacent portion of the peritoneal cavity. Falls upon the floor, under similar conditions, have also been productive of a like result. The gall bladder and the cystic duct, especially the former, appear to be the portions of the biliary system which are most liable to be ruptured as the result of external violence; perhaps this frequency may be explained by the fact that these parts of the biliary system are the places where gall stones are most frequently located. In rare cases, the right or left hepatic duct, the common hepatic duct, or the common bile duct, have been found to be ruptured as the result of an external injury. According to Routier,[1] it is probable that in cases of severe injury, such as when the wheel of a waggon passes over the abdomen, the abdominal wall is strongly pressed back underneath the liver so as to cause a sharp and sudden bending or compression of the biliary canals between the liver firmly forced into the concavity of the diaphragm and against the anterior aspect of the posterior abdominal wall on the one part, and the bending of the abdominal parietes on the other part, the biliary channels being then pulled upon and torn. The rupture appears always to occur in the front wall of the ducts, apparently owing to the mechanical force obliterating the lumen of the common bile duct and driving the contained bile towards the gall bladder or the cystic and hepatic ducts, which, being unable to find an exit, is forced through the walls of one of the channels, and a rupture is thus produced. The external violence may be so severe as to give rise to a complete separation of the gall bladder from its connections with the liver, and it has been found lying free in the peritoneal cavity, with a small portion of liver substance and a part of its cystic duct attached to it. In this class of case the patient usually dies at an early stage after the reception of the injury, the cause of death being severe shock, collapse, and internal hæmorrhage. Ulcerative processes affecting the walls of the biliary passages are, in most cases, due to the irritation which is caused by the presence of biliary calculi, and they may extend through the walls of the affected portion and establish a communication between the lumen of the gall bladder or of one of the bile ducts and the peritoneal cavity, and in this manner a rupture is produced which allows the free passage of bile and pus into the peritoneum. Ulceration of the mucous membrane of the gall bladder may occur during the course of an attack of typhoid fever, owing to the presence of the typhoid bacillus within the gall bladder, and give rise to perforation, which is followed by the passage of the contents of the gall bladder into the peritoneal cavity. Localised tuberculosis of the walls of the gall bladder has also been mentioned as a cause of ulceration and perforation. An ascaris which has passed from the duodenum into the common bile duct, or into the gall bladder, may cause immediate rupture of the walls of the duct or gall bladder, and pass thence into the cavity of the peritoneum, or it may die and set up a local inflammation and ulceration, which is followed at a later period by perforation and rupture. Epithelioma or carcinoma of the gall bladder, or of one of the bile ducts, may cause perforation into the peritoneal cavity, but this is a very uncommon sequence of these pathological conditions, since in nearly every case adhesions are formed with the surrounding structures before perforation takes place as the result of an extension of the ulceration through the wall of the canal. Extensive dilatation of the bile ducts or gall bladder, or both, which has been produced by an obliteration of the lumen of the common bile duct, owing either to compression from without or to the presence of an impacted gall stone, or to the existence of a fibrous or malignant stricture, may result in a thinning of the walls of some portion of the biliary ducts, followed by a rupture and passage of the fluid contents into the peritoneal cavity.

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[1] Routier, *Bull. Soc. de chir. de Paris*, 1892, p. 773.

From the same causes the walls of the intra-hepatic bile ducts may give way and allow an extravasation of bile into the substance of the liver. Ruptures, contusions, and laccrations of the liver are in all cases accompanied by injury to the intra-hepatic bile ducts, but the symptoms which are due to the simultaneous hæmorrhage and shock mask or disguise those symptoms which are referable to the extravasation of bile. After a rupture of some part of the gall bladder or bile ducts has taken place, the bile, or the fluid contents of the injured viscus, may either be poured out slowly, or at once and in large quantities. If the bile is poured out slowly into the peritoneal cavity, adhesions may be formed, and the effused fluid will collect in a localised encysted portion of the peritoneum. This encysted cavity may enlarge so as to form a fluid tumour in the hypochondriac and hepatic regions, which attains a considerable size, displaces the neighbouring viscera, pushing upwards the lung and diaphragm, and appearing as a prominence of the abdominal walls in the right hypochondriac regions and the adjacent part of the abdomen. A cyst of this kind may contain several gallons of fluid, consisting largely of bile. When a rupture or perforation occurs as the result of an inflammatory ulceration, septic peritonitis is much more liable to occur at an early stage than in those cases where the rupture is due to a simple traumatism. Experiments by Brodie, Gmelin, and Tiedemann, have shown that when the common bile duct has been occluded by the application of ligatures, ulceration of the walls of the occluded duct takes place after a few days, and bile is extravasated into the surrounding structures, and a large bile-containing cyst is established, into which the proximal and distal ends of the occluded duct open. After the expiration of two to four weeks, the biliary passage became restored. I have made similar experiments in cats, which have given like results. Several analogous cases have occurred in man, and have been recorded by Fryer and Barlow. If the bile passes at once, and in large quantities, into the peritoneal cavity, in most cases an acute general peritonitis will be established, which will usually prove fatal.

*Symptoms.*—The symptoms of rupture of the gall bladder or bile ducts may be masked, or rendered obscure, by the symptoms which are dependent upon injuries of other viscera, which have been caused by the same traumatism. When the injury to the gall bladder or bile ducts is uncomplicated, the symptoms vary, according to whether the bile passes into the peritoneal cavity and sets up a general peritonitis, or collects in a localised portion of the peritoneum, which is shut off from the rest by the development of adhesions, or a fibrous limiting membrane, or no extravasation of bile takes place at all. If the bile passes at once into the general peritoneal cavity, the abdomen becomes swollen and the seat of much pain, and this is accompanied by much collapse, and all the signs of an acute general peritonitis. In one case of this kind which occurred in St. Bartholomew's Hospital, a man, æt. 50, received a kick in the hepatic region, which caused a rupture of the gall bladder close to its attachment to the liver. He died in fifteen hours, from shock, collapse, and acute peritonitis. The gall bladder had apparently been distended at the time of the injury, owing to the presence of a calculus in the neck of the viscus. In another case the patient fell over a log of timber and suffered from a rupture of the gall bladder in the neighbourhood of the fundus, and he died from peritonitis five weeks after the reception of the injury. When the gall bladder is the seat of the rupture, the bile usually passes immediately into the peritoneal cavity and gives rise to symptoms of acute peritonitis, which may be either general or localised. In the latter case the effused bile becomes shut off from the rest of the peritoneum by the development of adhesions; and the symptoms at first are those of an acute localised peritonitis, which is followed by the formation of a fluctuating swelling in the abdomen, usually in the right hypochondriac region, and the occurrence of jaundice. When the bile ducts are the seat of the rupture or perforation, the escape of bile may be delayed for several hours or days, or, as in the case of the gall bladder, it may take place immediately after the occurrence of the injury. When the whole of the bile which is secreted by the liver passes into a localised portion of the peritoneum, the patient is constipated, and the stools are white or clay-coloured. According to Courvoisier,[1] jaundice has been observed ten times in twenty-four cases, and in only eight of these was absence of colouring matter in the fæces noticed. When there is no extravasation of bile, the symptoms may be slight or almost non-existent. In these cases there is usually localised pain in the right hypochondriac region, or even general abdominal pain, accompained by vomiting and slight dyspnœa, together with slight shock and collapse. These symptoms may soon disappear, or they may be followed by those of extravasation, if this condition takes place at a later period. When rupture or perforation has taken place, and the contents of the gall bladder have passed into the peritoneal cavity, bile can usually be detected in the urine at a very early stage after the reception of the injury. When the perforation or rupture of the gall bladder or bile ducts is due to a septic process, or these channels are infected with septic micro-organisms at the time of the rupture, acute general septic peritonitis in practically every case at once develops.

*Diagnosis.*—It is often very difficult in this class of cases to make an exact diagnosis. If after the occurrence of an abdominal injury the patient soon becomes jaundiced, and bile appears in the urine, and in addition signs of acute peritonitis become manifest shortly after the injury has been inflicted, a rupture of the gall bladder or some other part of the biliary system may be suspected. If a localised abdominal swelling develop, especially in the right hypochondriac region or in the adjacent portion of the abdomen, after the reception of an abdominal injury, and is associated with the occurrence of jaundice, constipation, and white or clay-coloured stools, the existence of rupture of the gall bladder, or of one of the bile ducts, may be suspected; and if this swelling is found to contain biliary fluid when it is punctured with the needle of an aspirator, the diagnosis of such a condition is made more certain. The occurrence of attacks of severe biliary colic, followed by symptoms of shock and collapse, together with signs of acute general peritonitis, point to the existence of a gall stone which has perforated the wall of the gall bladder or bile duct, and passed into the peritoneal cavity together with a quantity of bile and probably also purulent material.

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[1] Courvoisier, *op. cit.*

A woman, aged 75, was recently admitted to the Metropolitan Hospital (under Mr. Goodsall) with all the signs of acute intestinal obstruction. The condition commenced with a sudden severe attack of abdominal pain, which apparently was not most marked in the right hypochondrium. Severe vomiting followed, and persisted until three days later, when she was brought to the Hospital. On examination, the abdomen was distended, the coils of intestine being visible through the anterior abdominal wall, the vomiting was fæcal, and there was no passage of air or fæces by the rectum. Acute peritonitis was diagnosed, and it was thought to be due to a perforation of the intestine, probably the vermiform appendix. There was no jaundice. The abdomen was opened, when a large quantity of bile-stained fluid escaped. This was examined, and found to give the reactions for bile. The region of the gall bladder was examined, and adhesions to the surrounding viscera were met with. The condition of the patient being very serious, it was thought best to empty as much fluid as possible from the peritoneal cavity, and to pass a drainage tube down to the region of the gall bladder. The patient did not recover from the shock following the operation, but died shortly afterwards. Post-mortem, a small perforation due to ulceration was found at the apex of the fundus of the gall bladder. The viscus was of ordinary size, and contained several small calculi. No calculi were present in the peritoneal cavity. This is a most unusual case, owing to the difficulty experienced in making a diagnosis, since there were no symptoms which suggested that the gall bladder was the seat of perforation.

*Treatment.*—In those cases of obscure abdominal injury in which rupture of the gall bladder or one of the bile ducts is suspected, but in which the diagnosis is uncertain, it is advisable to keep the patient absolutely at rest in bed and not to allow any movements, so that, if there has been any rupture, the extravasation of bile or other fluid may be either prevented or at least limited as far as is possible, and the formation of adhesions induced. If there is a tendency to vomiting, small quantities of warm water may be given by the mouth to prevent it and to allay thirst. Liquid food only must be given, and this must be limited in amount. If constipation occur, the bowels may be relieved by the administration of enemata, but not by aperients given by the mouth. If a localised fluctuating swelling become apparent in the abdominal region, it may be emptied either by the needle of an aspirator, care being taken to avoid the puncture of any of the important viscera or blood vessels, or by direct incision and evacuation of the fluid. This latter operation has been called Secondary Laparotomy. When the injury is followed by the development of signs of acute peritonitis, together with symptoms of jaundice and the appearance of bile in the urine, a laparotomy ought to be immediately performed, the incision being made above the umbilicus, either in the median line or in the right linea semilunaris, and the hepatic region of the abdomen explored. When the severity of the injury and the point of its application suggest rupture of the biliary passages, the hepatic region ought to be at once explored by an abdominal operation (Immediate Laparotomy).

The gall bladder and the cystic duct should be first examined, and then the structures which lie in the portal fissure of the liver and in the lesser or gastro-hepatic omentum. If the gall bladder is found to be ruptured, the injured portion should at once be dealt with. If the rupture is small and is due to traumatism, whilst the gall bladder is not the seat of a suppurative affection, it may be closed by the application of several fine silk sutures applied in two tiers, after the method of Lembert. If the rupture is due to ulceration, either from the presence of a calculus or from the perforation of an ulcer in the wall of the organ, and if it is situated near the fundus, the margins of the aperture should be stitched to the margins of the abdominal wound, a drainage-tube inserted, and the injury allowed to close up gradually by granulation. If the rupture is large, and involves the greater portion of the longitudinal or transverse axis of the gall bladder, or if a calculus has perforated the wall in the immediate neighbourhood of the cystic duct, or if the cystic duct itself has been torn across, the entire gall bladder should be removed (cholecystectomy), and the distal end of the cystic duct closed by the application of a silk ligature. When the common bile duct is the seat of the injury, and the rupture is small and in the long axis of the duct, the rent should be closed by several fine silk sutures applied close together, and by Lembert's method. If the common bile duct is torn across, or if it is found impossible to close a rupture in it by sutures, a silk ligature should be applied to each extremity, and then an anastomosis between the fundus of the gall bladder and the adjacent portion of the duodenum or other part of the intestine (cholecystenterostomy) established, provided the cystic duct is patent. If the common bile duct is torn across, and it is found that the gall bladder has been the seat of a former inflammatory affection which has caused it to shrink and be represented by a mass of fibrous tissue, or the cystic duct has been obliterated, then it is only possible to make an attempt to establish an anastomosis between the two ends of the bile duct, or between the proximal end of the bile duct and the adjacent portion of the intestine, or failing both these, to apply a ligature to the ruptured ends, and hope that a communication may become established at a later period. When the common hepatic duct, or either the right or left hepatic ducts are ruptured, it is only possible to apply a ligature to both of the ruptured ends, and hope that adhesions will be formed which will result in the re-establishment of a communication between the two portions of the duct, and the biliary canal again become patent, as was the case in the dogs experimented upon by Tiedemann and Gmelin, and in a cat which has been experimented upon by myself. The exact methods of procedure in the performance of the surgical operations are described later in Chapters XXV. and XXVI.

*Prognosis.*—If the nature of the injury can be diagnosed at an early period after its reception, the prognosis ought to be moderately good in uncomplicated cases. When the gall bladder or the cystic duct is the seat of the rupture, the case is much more likely to have a favourable termination than when either the common bile duct or one of the hepatic ducts is involved. When the common bile duct is ruptured, and the gall bladder is represented by a mass of fibrous tissue, or is the seat of an inflammatory affection, owing to the presence of gall stones, the prognosis is worse than when this viscus is in its normal condition, since, in the latter case, it is possible to re-establish the biliary canal by making a communication between the intestine and the fundus of the gall bladder. Ruptures and injuries of the gall bladder and cystic duct are less dangerous to life than similar affections of the common bile duct or one of the hepatic ducts. In all cases, however, the injury must be regarded as of a serious nature, and a guarded prognosis given, but there is no doubt that the danger of the entrance of bile into the peritoneal cavity has been very much exaggerated. When the ruptured portion of the biliary canal is the seat of a septic inflammation, it is very liable to cause the development of a septic peritonitis, and hence in this class of case the prognosis is much worse.

Courvoisier[1] says that in eighteeen instances out of thirty-three cases which he has collected from surgical literature, puncture was practised for the relief of a rupture of the biliary passages. Purulent peritonitis was caused by the puncture in four cases, each of which terminated fatally. In three the puncture was not followed by septic complications, but death resulted from exhaustion. Eleven of the patients recovered, apparently owing to the puncture having been performed. In one, however, a biliary fistula was established, which closed at a later period. Terrier and Auvray[2] have collected three other cases which have been treated by this method. One patient died, and the other two recovered. When puncture has been performed, it has been found that repeated puncture is necessary, in some cases the collected bile having been emptied seven or even ten times. Occasionally, however, a single puncture has been sufficient.

Terrier and Auvray[3] state that "secondary laparotomy" has been performed seven times, with four cures and three deaths. Death was due in one of the fatal cases apparently to exhaustion, and occurred a few hours after the operation; in a second, there was deep jaundice, and calculi were found in the common bile duct after death; whilst in the third, the patient died from collapse after the operation had been performed.

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[1] Courvoisier, *op. cit.*

[2] Terrier et Auvray, *Rev. de chir.*, Paris, 1897, p. 36 *et seq.*

[3] *Ibid.*

# CHAPTER XVIII.

## CHOLELITHIASIS.

By the term Cholelithiasis we mean that pathological condition of the liver and biliary system which tends to give rise to the development of gall stones. Gall stones, biliary calculi, or biliary concretions, are solid bodies of variable size and shape, which have been formed as a result of pathological processes occurring in some part or parts of the excretory apparatus of the liver. A number of different conditions appear to be associated with a tendency to the formation of calculi in both the intra-hepatic and extra-hepatic biliary ducts.

*Mode of formation and pathology.*—In the majority, if not in all cases of gall stones, the formation of these concretions is associated with the presence of an obstruction to the free outflow of the bile from the bile duct into the duodenum. This obstruction may be complete, but it is more usually only partial, and it is often dependent upon the existence of inflammatory processes within the intestine. The mere existence of an impediment to the free flow of the bile into the intestine does not of itself appear to be sufficient to give rise to the development of gall stones within the gall bladder or the biliary ducts. The exciting cause seems, in some of the cases which have been carefully examined by Naunyn,[1] to be an inflammatory condition of the mucous membrane lining the interior of the biliary ducts and the gall bladder, which has been caused by the presence of the *Bacterium coli commune.* This bacillus is a constant inhabitant of the alimentary canal, and when the flow of bile through the common bile duct has been slowed, owing to some abnormal condition, it has been assumed that this micro-organism obtains an entrance into the interior of the biliary system by passing through the common opening of the bile duct and pancreatic duct into the second portion of the duodenum, but the evidence upon which this assertion is based appears somewhat inconclusive. This bacillus, however, is slightly motile, and it is possible that it may obtain an entrance in the manner which has been suggested. It also appears possible, if an obstruction to the lumen of the alimentary canal, especially in the third portion of the duodenum, becomes established even temporarily, owing to pressure from without or by tight-lacing, or when the colon is loaded with fæces, that, when the ordinary movements of peristalsis take place, the contents of the small intestine may be forced a short distance along the common bile duct, and by this means any micro-organisms which happened to be in the duodenum would pass into the common bile duct. When these organisms have effected an entrance into the bile duct, it is probable, especially in those cases in which the current of bile has been slowed, that they will pass into the gall bladder along the cystic duct, and into the liver along the hepatic ducts. There seems, however, in such cases a greater probability of these organisms being carried to the gall bladder, since in the intervals between the periods of digestion, the bile which has been secreted by the liver passes along the cystic duct into the gall bladder, where it is stored until it is required in the intestine after the next meal. Naunyn[1] thinks that the sequence of events in the formation of gall stones within the gall bladder is as follows, namely:—After the bacilli (*B. coli commune*) have obtained an entrance into the bile ducts and the gall bladder, they grow and multiply, and induce the development of a catarrhal condition of the mucous membrane, upon the existence of which the formation of gall stones depends. The bacilli act as an irritant to the mucous membrane lining the gall bladder, either mechanically or owing to the production of chemical products of the nature of ptomaines or toxins, and in this manner produce an inflammatory condition of the epithelial cells which cover the internal aspect of the mucous membrane. As a result of this inflammatory condition, the metabolic processes of the epithelial cells appear to undergo considerable modifications. If the cells are examined with the microscope, many of them will be seen to be swollen, and their interior to be occupied by myelin-like masses, which are being extruded upon the internal surface of the mucous membrane and there crystallising so as to form small masses or clumps of cholesterin. In some places these swollen cells may become aggregated together so as to form a small mass, in which there may be a few blood corpuscles. Crystals of cholesterin may be deposited on the surface of this mass, and in this manner the formation of a biliary calculus commences. As a calculus which has arisen in this way increases in size, numerous layers of cholesterin, or of compounds of bilirubin and calcium, are deposited upon the exterior, and gradually give rise to an enlargement in all the dimensions of the calculus. Cholesterin which is deposited thus may come from that which is in solution in the bile within the gall bladder, or it may come from small masses which have been set free from the epithelial cells in the manner described in the early stages of the formation of the calculus. Frerichs,[1] in his treatise upon the diseases of the liver, says that the formation of gall stones is due to a stagnation of the bile in the gall bladder. When this slowing of the flow of bile has existed for a time, an excess of mucus is secreted by the walls of the gall bladder, and this, he says, undergoes decomposition, and gives rise to the development of an acid reaction, which causes a precipitation of the cholesterin and the bilirubin. The cholesterin is deposited in the form of crystals, and the bilirubin in the form of an amorphous insoluble calcium compound. Before gall stones were formed, Frerichs thought that these precipitated substances remained in the cavity of the gall bladder for a time, and became incorporated with the mucus and shed epithelial cells, which resulted from the inflammatory condition of the mucous membrane. Many observations have been made which tend to demonstrate that typhoid fever is frequently followed by an attack of cholelithiasis. The pathology of these cases is similar to that described above. The biliary passages are infected with the bacillus of typhoid (the bacillus of Eberth), and an inflammatory condition of the bile ducts and the gall bladder becomes established. This angiocholitis and cholecystitis causes the cholesterin of the bile to be precipitated, and calculi commence to form. In support of this view, some investigators have shown that the gall bladder often contains the specific bacilli, and that the interior of small young calculi frequently consists of numerous typhoid bacilli. This view of the pathology of gall stones is said to be supported by the fact that cholelithiasis often follows an attack of typhoid fever: and inflammatory lesions of the gall bladder or the bile ducts not uncommonly occur as the result of infection of the biliary passages with the specific micro-organism of typhoid fever.

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[1] Naunyn, "Klinik d. Cholelithiasis," 1892.

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[1] Naunyn, *loc. cit.*

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[1] Frerichs, "Diseases of the Liver," *New Syd. Society's Trans.*, 1861.

The micro-organisms of suppuration, streptococci and staphylococci, have been found in the bile within the gall bladder of patients suffering from gall stones and cholecystitis. No explanation has yet been given why the bacillus of typhoid fever, the *B. coli commune*, or the micro-organisms of ordinary suppuration, when they have gained an entrance into the interior of the bile ducts and the gall bladder, in some cases cause the development of an acute cholecystitis and angiocholitis, which may result in the formation either of an abscess of the liver or an empyema of the gall bladder, or both, and in other cases give rise to cholelithiasis and the formation of gall stones. The degree of virulence of the bacteria when they infect the biliary passages has been suggested as the explanation of the different varieties of inflammation. When the micro-organisms are very virulent, they cause an acute inflammation of the biliary passages, and when they are attenuated, or have lost much of their virulence, they set up a subacute inflammation which terminates in the establishment of cholelithiasis. No trustworthy evidence has been brought forward in support of this view of the pathology of the affection.

The amount of the bile acids present in the bile has been thought to have some connection with the formation of gall stones. The bile acids help to keep the cholesterin in solution, and if from any cause the relative quantity of these acids is diminished, either by an increase in the amount of cholesterin secreted by the cells of the mucous membrane of the gall bladder (as in inflammatory conditions of the membrane), or owing to a diminution of the quantity secreted by the hepatic cells (a condition which is said to be favoured by a non-nitrogenous diet), the cholesterin which is in solution in the bile is precipitated and small calculi commence to form. The greater frequency of cholelithiasis in Germany and Switzerland has been explained on this hypothesis, namely, that Englishmen live on a diet which is much more nitrogenous than that of the Germans. A similar argument has also been adduced to explain the greater frequency of gall stones in females and in old people. The grounds upon which these arguments are based appear to be too theoretical to afford a reasonable and correct explanation of the occurrence of gall stones.

The present state of pathological knowledge concerning the development of cholelithiasis appears to indicate that two conditions are requisite for the formation of a gall stone, namely, (*a*) the presence of an obstruction to the free flow of bile from the gall bladder or the biliary ducts; and (*b*) the infection of the biliary ducts and gall bladder by a variety of micro-organism which is able to induce a subacute inflammation of the mucous membrane of the affected structures.

Further investigations on the causes of cholelithiasis will probably throw more light upon this somewhat obscure part of pathology.

When bile which is exposed to the atmosphere undergoes decomposition, the cholesterin is not precipitated even when the fluid has an acid reaction, hence the theory of Frerichs [1] cannot be accepted in its entirety, although, in conjunction with the observations of Naunyn,[2] it appears probable that stagnation of the bile first occurs, and then when the *B. coli commune* has obtained an entrance the conditions are favourable to the development of a gall stone.

In a certain number of cases which have been recorded by different observers, foreign bodies appear to have been important agents in the formation of gall stones. Naucke described a case in which a steel needle formed the nucleus of a gall stone, and Lobstein [3] gives an illustration of a case in which a dried-up round worm (*Ascaris lumbricoides*) was found in the interior of a calculus, whilst Buisson [4] found the interior of a gall stone which was obtained from the body of an ox to consist of a desiccated liver fluke (*Distoma hepaticum*). In other cases small plugs of mucus, collections of bacteria, and blood clots have been found to form the interior of biliary calculi. A small shrivelled-up hydatid cyst has also been discovered in the interior of a gall stone. In other cases the core is composed of a group of crystals of calcium carbonate, which have been formed as an excretion from the epithelial cells of the wall of the gall bladder; whilst occasionally small casts of the intra-hepatic bile capillaries seem to have been the nucleus around which a deposit has taken place, with the resulting formation of a calculus.

The presence of a foreign body within the gall bladder does not invariably cause the precipitation of cholesterin and the formation of a gall stone. Mignot[1] has made some experiments upon this point, and he finds that the presence of a foreign body within the gall bladder, so long as the viscus remains in an aseptic state, does not cause a condition of cholelithiasis, or a deposition of cholesterin. When, however, the gall bladder became infected with an attenuated microbe, cholesterin crystallised out, and was deposited on the surface of the foreign body.

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[1] Frerichs, *loc. cit.*

[2] Naunyn, *loc. cit.*

[3] Lobstein, "Nouveau catalogue de Musée Anatomique de Strasbourg," 1843.

[4] Buisson, "Ueber die Galle" (German translation).

*Place of formation.*—In nearly all cases of cholelithiasis which are examined, it is found that the gall stones occupy either the interior of the gall bladder or the lumen of the cystic or common bile duct, and only much more rarely are calculi met with in the right or left hepatic ducts or their smaller ramifications. In occasional cases a stone is found in the common hepatic duct, but this condition is not common. I have recently seen several cases, post-mortem, in which the right and left hepatic ducts and their branches were enormously dilated, and their lumen filled with numerous and large calculi, but in each of these cases the gall bladder also contained a number of calculi. In one case which I have seen, the intra-hepatic biliary ducts were the seat of a deposit of a considerable amount of bilirubin combined with calcium salts. No definite calculi could be distinguished, but the interior of the intra-hepatic bile ducts were dilated and had an incrustation of the bilirubin-calcium compound upon their internal walls. The liver from which this specimen was obtained is in the Museum of the Royal College of Surgeons of England. The gall bladder appears to be the locality where the great majority of biliary calculi take their origin, and in most of those cases in which calculi are found in the right or left hepatic ducts, and in the portal fissure of the liver, they have been formed in the gall bladder, and have passed thence into the localities where they have been found. It appears possible, however, in some cases that the calculi have arisen in the commencement of the intra-hepatic bile ducts. In the case which was mentioned above, it seemed to be without doubt that the deposit of bilirubin and calcium had taken place within the liver. If we accept Naunyn's view of the mode of formation of gall stones, it is easy to understand why gall stones in most cases commence within the gall bladder, since this viscus is much more liable to be the seat of an inflammatory process than the intra-hepatic bile ducts, and stagnation of the bile can more readily occur.

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[1] Mignot, Thèse de Paris, 1896.

*Structure.*—A gall stone generally consists of three portions: (*a*) a central core or nucleus; (*b*) a middle layer of considerable thickness, consisting of radiating crystals of cholesterin; (*c*) an external, thin, dense laminated layer of bile pigment and cholesterin.

The composition of the nucleus has been already discussed. It generally has a dark green or somewhat black appearance, owing to the presence of a quantity of bile pigments. In some nuclei large numbers of bacilli have been found. In most cases the nucleus is solid; but occasionally, owing to desiccation, a honeycombed appearance is met with. The middle layer is usually the thickest, and forms the greater part of the calculus. It consists of layers of crystals of cholesterin, the crystals being arranged in a radiating manner and the laminæ being superimposed. This layer may be white or light-coloured in appearance, but in many cases it is somewhat yellow in tint, owing to the permeation of a small quantity of bile colouring-matter. This middle layer occasionally has a uniform soapy appearance, and shows no sign of lamination or crystallisation. The external layer is thin, dense, dark green or brown in colour, and has a varied consistence. Sometimes it is composed of layers of cholesterin or of calcium carbonate alternating with layers of pigment, or it is made up of a compound of calcium carbonate and bile pigment. This external layer may be absent; the surface

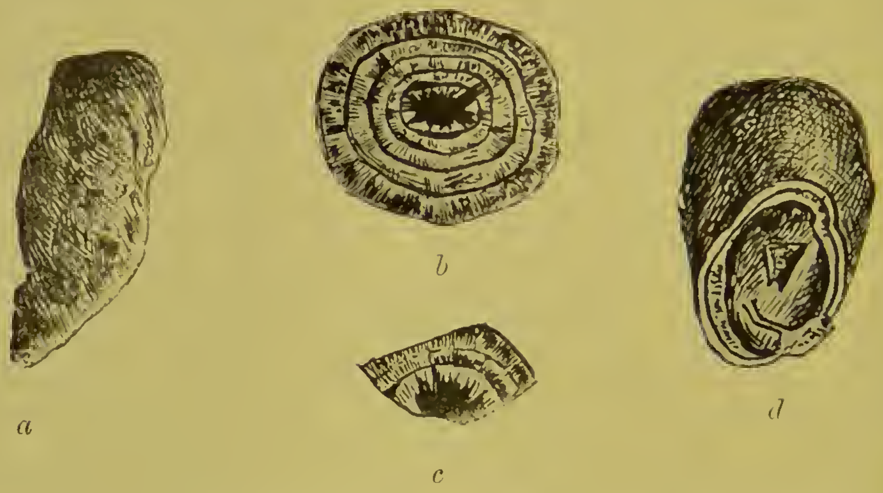

FIG. 28.—Varieties of gall stones. *a*, an oval-shaped single calculus; *b*, section of a round calculus showing lamination; *c*, section of a calculus triangular in shape, which shows from its lamination that it is probably part of a larger calculus which has become broken up (this calculus was one of a large number which were taken from the same gall bladder); *d*, an oval single calculus showing the structure of its interior.

of the stone is then rough, and is formed by the free ends of the radiating striæ of cholesterin, upon which has been deposited a small amount of pigment.

*Varieties.* — The intra-hepatic calculi, which have their primary origin within the liver, most commonly consist of a compound of calcium and bilirubin, but in occasional cases they consist of cholesterin. Those calculi which have their origin in the gall bladder, have been classified by Naunyn[1] as follows, namely—(*a*) Calculi composed of pure cholesterin. (*b*) Stratified cholesterin calculi. (*c*) Common biliary calculi, which are usually numerous, multiple, and faceted. (*d*) Mixed bilirubin-calcium calculi, which are single or few in number, and when multiple may be faceted. Some of these calculi may possess a nucleus of cholesterin, and in all cases there is a considerable amount of cholesterin mixed with the bilirubin-calcium compound. (*e*) Calculi of pure calcium-bilirubin. These calculi are rare, and when met with they are usually of small size. They do not consist of absolutely pure bilirubin-calcium compound, but in some cases it is almost impossible to detect any other substance. They often contain small quantities of cholesterin or biliverdin-calcium, and in occasional cases small traces of the other kinds of bile pigments. (*f*) Rarer forms of biliary calculi, among which are included the following—(1) small amorphous or imperfectly crystallised cholesterin calculi; (2) calculi containing calcium carbonate; (3) conglomerate calculi; (4) calculi which have the form of casts of the intra-hepatic ducts.

*Occurrence.*—(*a*) *Sex.*—Biliary calculi are found to occur in the female sex in a considerable majority of cases. Schröder,[2] in an investigation which he carried on in Strassburg, found gall stones in 4·4 per cent. of all male subjects, and in 20·6 per cent. of all female subjects which were examined. From these statistics it appears that gall stones occur about five times as frequently in women as in men, a fact which has been noticed by a number of observers.

(*b*) *Period of life.*—Children and young adults are only very rarely the subjects of gall stones, in fact children may be said to be quite free from the affection. According to the statistics of Schröder, which have been mentioned above, he found in the bodies of people under 20 that gall stones were present in only 2·4 per cent. of cases. In the third decade (21 to 30) the percentage was 3·2, in the fourth (31 to 40) 11·5, in the fifth (41 to 50) 11·1, in the sixth (51 to 60) 9·9, and in persons over 60 the percentage was 25·2. The more common occurrence of gall stones in old people has been explained by asserting that in old age the bile contains an increased amount of cholesterin, but this explanation does not appear based upon a sufficient number of trustworthy observations. Charcot and Pitres have shown that in old people the unstriped muscular tissue which under normal conditions forms a part of the wall of the bile ducts, undergoes a transformation into fibrous tissue, or atrophies, so that when this change has taken place a stagnation of the bile is liable to occur, and if calculi are formed within the gall bladder they will in all probability remain there, and their presence will be associated with few symptoms, since the absence of muscular tissue in the walls and duct of the viscus will favour their retention in the locality where they have been first formed. This theory offers a reasonable explanation of the fact that gall stones are much more common in the gall bladder of old people, and when they are present they are only occasionally accompanied by the appearance of symptoms of biliary colic.

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[1] Naunyn, *loc. cit.*

[2] Schröder, Inaug. Diss., Strasburg, 1893.

Brockbank[1] gives the following table of the frequency of the occurrence of gall stones in Manchester. For the sake of contrast, Schröder's table is given as well:—

TABLE I. (Manchester Post-mortems).

| Age. | Total number of Post-mortems. | Number of Cases in which Gall Stones were found. | Percentage. |
|---|---|---|---|
| 0–20 | 67 | 2 | 2·9 |
| 21–30 | 112 | 6 | 5·3 |
| 31–40 | 180 | 6 | 3·3 |
| 41–50 | 189 | 14 | 7·3 |
| 51–60 | 128 | 12 | 9·3 |
| 61 and over | 66 | 9 | 13·6 |
| Total . . | 742 | 49 | |

TABLE II.—SCHRÖDER (Strassburg Post-mortems).

| | | | |
|---|---|---|---|
| 0–20 | 82 | 2 | 2·4 |
| 21–30 | 188 | 6 | 3·2 |
| 31–40 | 209 | 24 | 11·5 |
| 41–50 | 252 | 28 | 11·1 |
| 51–60 | 161 | 16 | 9·9 |
| 61 and over | 258 | 65 | 25·2 |
| Total . . | 1150 | 141 | |

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[1] Brockbank, "Gall Stones," London, 1896, p. 44.

| Sex. | Brockbank. | Schröder. |
|---|---|---|
| Males . | 2·9 per cent. of all post-mortems. | 4·4 per cent. of all post-mortems. |
| Females . | 13·3 per cent. of all post-mortems. | 20·6 per cent. of all post-mortems. |

*Predisposing causes.*—All those conditions which impede or obstruct the free flow of bile along the biliary passages favour the commencement of the formation of biliary calculi. The movements of respiration, especially those of the abdominal type, are important factors in the maintenance of the normal flow of bile along the bile ducts, both intra-hepatic and extra-hepatic; hence it follows that when, owing to any cause, these movements are interfered with, the possibility of the formation of gall stones is increased. In pregnancy, for example, the free descent of the diaphragm is impeded, and the intra-abdominal pressure is increased, whilst in many cases the anatomical relations of the abdominal viscera are altered. The presence of an intra-abdominal tumour, such as a cyst of the kidney or of the ovary, acts in a similar manner. The tendency to the formation of biliary calculi in the female sex is also much increased by "tight-lacing" and sedentary habits. Many authors consider that this is the true explanation of the fact that gall stones are much more frequently met with in women than in men. In the majority of cases of women who suffer from gall stones, it is found that they have borne children and usually have had several pregnancies. The costal type of respiration, which is normal in the adult female, does not tend to cause compression of the liver to the same extent as the diaphragmatic movements in the male, and when this is associated with a tumour of the abdomen, which still further interferes with the free movements of the abdominal viscera, it seems probable that this combination of circumstances is one of the main predisposing causes in the formation of gall stones. In a similar manner the practice of wearing tightly-laced corsets appears to predispose to the development of a condition of cholelithiasis. In many of these cases the liver becomes constricted, and often a distinct furrow is formed upon its external surface which tends to divide the gland into two superimposed halves. All these causes act by inducing a condition of stasis of the bile within the biliary passages which favours the commencement of the formation of a calculus. Diseases of the intra-thoracic viscera, which tend to impede or slow the normal free movements of respiration, also act as predisposing causes. Age, as we have already seen, is an important factor. The presence of distomata or ascarides in the hepatic system or in the alimentary canal increases the probability of the development of gall stones, owing to the fact that these parasites may cause an obstruction to the free flow of bile, and may also be the means of introducing micro-organisms into the bile ducts. The presence of a foreign body in the gall bladder or in one of the larger bile ducts would also act as a predisposing cause. The existence of any pathological condition which tends to give rise to a temporary obstruction to the upper portion of the small intestine, may also, as we have seen, be an important factor in the formation of gall stones, owing to the possibility of the peristaltic movements of the intestine causing the contents of the duodenum to pass into the common bile duct through the aperture upon the biliary papilla.

Cancer of the gall bladder has, by some authors, been said to be an important cause in the formation of gall stones; but although this may be true in a small number of cases, it appears much more probable that the gall stones are the inducing cause of the carcinomatous condition. Cancer of the larger bile ducts may also be a cause of the formation of gall stones, owing to the obstruction to the free flow of bile which is induced, and also to the possibility of the occurrence of infection of the biliary passages by organisms from the adjacent portion of the alimentary canal. In most cases of cancer, however, the calculi have been developed before the onset of the malignant disease, but it is possible, and even probable, in a few cases, that the occurrence of a cancerous affection of some portion of the biliary passages is followed by the development of gall stones (Fig. 29).

*Symptoms.*—Biliary calculi may exist in the gall bladder, or occasionally in some portions of the bile ducts, without giving rise to the manifestation of any symptoms by which their existence can be diagnosed or even surmised during life. Usually, the first symptoms to be noticed are the occurrence of pains in the upper portion and right side of the abdomen, in the right hypochondriac and epigastric regions. These pains may be only slight in character, and give rise to a more or less constant feeling of fulness and heaviness in the right hypochondrium, together with a dragging sensation over the hepatic area. In most cases, however, there occur sooner or later paroxysms of severe pain. The pain in these attacks is at first localised in the right hypochondriac or the epigastric region, from which

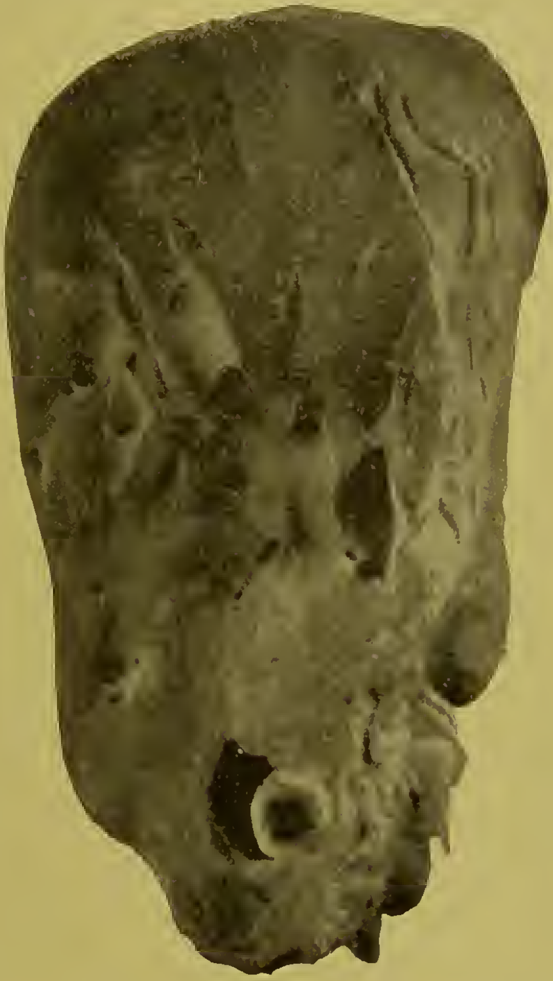

FIG. 29.—Carcinoma of the gall bladder (primary). Section through the liver and gall bladder of a man æt. fifty-three. The gall bladder is greatly diminished in size, and contains a calculus; its walls are thickened and infiltrated with a malignant growth, which spreads into the adjoining liver tissue in all directions for about $1\frac{1}{2}$ to $2\frac{1}{2}$ in. At the time of the post-mortem examination the shrivelled gall bladder contained a milky, thin, mucoid fluid. The bile ducts (intra-hepatic) are enormously distended, and contained a thin, yellow fluid. The liver was deeply jaundiced. Microscopically, the new growth consisted of fibrous tissue and alveoli lined with cubical epithelium.

a little later it radiates forwards over the anterior area of the abdomen, and especially towards the umbilicus, and also backwards towards the inferior angle of the right scapula. These paroxysms of pain may come on after taking some variety of physical exercise or after a meal, but in many cases they occur spontaneously without being preceded by any apparent exciting cause. Usually they commence during the daytime when the patient is up and about, but it occasionally happens that the patient wakes in the night with a paroxysm. An attack of pain of this kind may last for several minutes or several hours, and in severe cases even longer; but in most cases it is found to be of several hours' duration. The pains during an attack are often very severe, and may give rise to collapse or to sickness and vomiting. Frequently, when an attack of pain has lasted for a short time, a feeling of sickness followed by an attack of vomiting occurs, and then the paroxysm comes to a termination, and the patient is apparently well. These paroxysms of pain are often called gall-stone colic, biliary colic, or hepatic colic. They may be single or repeated. They are caused by the passage of a calculus from the gall bladder into the cystic duct, and thence into the common bile duct or other portion of the biliary passages. When a calculus has been formed within the intrahepatic ducts, an attack of biliary colic may be caused by the passage of the calculus downwards into a narrower portion of the biliary canal. In general it may be said that symptoms of biliary colic will appear when a calculus passes from one portion of the biliary system into another in which the lumen of the canal is somewhat narrower. In many cases, however, calculi have passed from the gall bladder along the cystic and common bile ducts into the alimentary canal, whence they have been voided per anum, and their presence has not been surmised until they have been discovered in the fæces, owing to an absence of any painful symptoms which might have indicated their existence. This condition appears to be more commonly met with in old people, in whom the muscular tissue of the walls of the bile ducts and the gall bladder has undergone a certain amount of degeneration. The calculus, in a certain number of cases, becomes arrested at some point in the course of the cystic or common bile duct, or even in one of the hepatic ducts, and according to the point of arrest there follows a train of symptoms which will be considered in detail later.

*Sickness.*—A feeling of sickness and general malaise may occur, which is quite independent and distinct from a paroxysmal attack. It is usually associated with the occurrence of constant pains in the right hypochondrium, and is often dependent upon the irritation of calculi in the gall bladder, or is experienced when a calculus passes into the neck of the gall bladder, but which is too large to pass along the cystic duct. This symptom is much more common in old people who suffer from biliary calculi, and in whom the muscular tissue in the walls of the biliary system has undergone a certain amount of atrophy or degeneration. In many cases an intense feeling of nausea precedes the onset of an attack of vomiting.

*Vomiting.*—An attack of vomiting often occurs towards the end of a paroxysm of biliary colic. The vomited matters are at first the contents of the stomach and then bile-stained material, and in rare cases it happens that a biliary calculus is found. In very rare cases, in which the vomiting is unusually persistent, it may happen that the vomited matter has a stercoraceous odour.

*Collapse.*—When the paroxysm of pain is very severe and protracted in duration, or the fit of vomiting very persistent, a condition of collapse, which is more or less marked according to the severity of the preceding attack, is the result. A certain amount of collapse is the usual sequence of a paroxysm of biliary colic, the patient becoming weak and prostrated, with a small feeble pulse, a cold clammy skin, and a lowered temperature. Mayo Robson[1] has recorded a case in which the patient died from the collapse which was induced by a protracted and severe

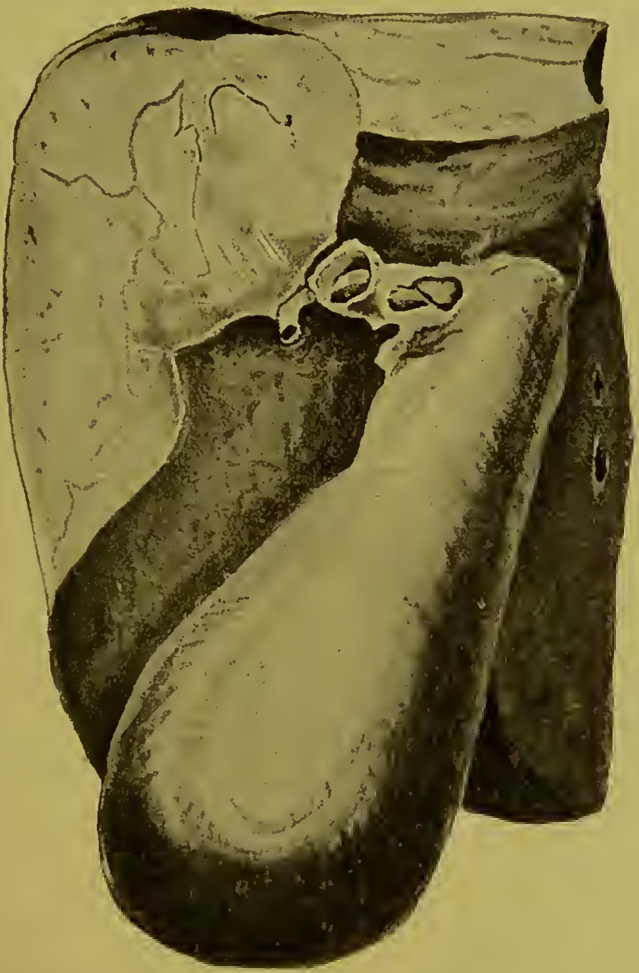

FIG. 30.—A portion of the right lobe of the liver with the gall bladder. The cystic duct and the gall bladder are both greatly distended, owing to the impaction of a calculus in the former.—*St. Barth. Hosp. Museum.*

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[1] Mayo Robson, "Gall Stones," 1892.

paroxysm of pain due to a gall stone. After death a calculus was discovered to be half expelled from the common bile duct into the duodenum, and still grasped by the ring of muscular tissue in the terminal portion of the wall of the common bile duct. Cases of this kind are, however, exceedingly uncommon.

*Calculi in the fæces.*—If the stools of a patient are examined after the occurrence of an attack of biliary colic, it occasionally happens that small or large calculi are found in the excreta, which have been passed per anum. In order to find these calculi, the excreta should be mixed with a weak solution of carbolic acid in water, then well mixed up, and finally passed through a fine wire sieve, of which the meshes are about one-twelfth of an inch square. When calculi are found after an examination of this kind, their composition and structure should be carefully ascertained, so as to make certain of their exact nature and character. In many cases, after an attack of colic, no calculi can be found in the fæces. This is due to the fact that the calculi which have been the cause of the pain have either become lodged or arrested in some part of the biliary system or alimentary canal, or the calculus may have slipped back from the cystic duct into the cavity of the gall bladder. In other cases, where the calculi are small and friable, they may have undergone disintegration in the alimentary canal, before they have arrived at the anus.

*Jaundice.*—When a biliary calculus becomes impacted in the common bile duct, an obstruction is produced to the flow of bile along this channel, and consequently into the alimentary canal; and if the obstruction is either complete or almost complete, it gives rise to the development of an attack of jaundice. In these cases the conjunctivæ become stained yellow, and soon afterwards the skin acquires a similar tint, whilst the urine is deep coloured, owing to the presence in this excretion of a certain amount of bile pigment. In the majority of patients who suffer from gall stones which become arrested in the common bile duct and give rise to an attack of jaundice, the discoloration of the skin lasts for several days after the paroxysm of pain has ceased, while in those cases in which the calculus remains impacted, it may last for a very long time. In rare cases, it may happen that an attack of jaundice occurs in connection with and as the result of the impaction of the biliary calculus, without being preceded by or associated with an attack of colic. This condition is much more commonly met with in old people, and is of very rare occurrence in young persons who are the subjects of gall stones. The usual course of events, however, is an attack of severe pain or biliary colic, followed immediately by the development of symptoms of jaundice, which may be more or less intense according to the extent and duration of the obstruction to the flow of bile along the common bile duct into the duodenum. In these cases the calculus becomes impacted either in the common bile duct or in the hepatic duct, and causes a temporary obliteration of the lumen of the bile canal. The bile which continues to be secreted by the liver after the occurrence of the obstruction, collects in that portion of the canal which is proximal to the seat of impaction, and when the intra-hepatic pressure and the pressure within the bile duct have arisen to a certain height, the bile passes into the lymphatic vessels of the liver, by which it is carried into the thoracic duct and thence into the general blood circulation, whence it is partially deposited in the skin and conjunctivæ, and partially excreted by the kidneys to be got rid of with the urine. The fæces in this class of case become clay-coloured, owing to the absence of bile-colouring matters; they undergo decomposition, and have a very foul odour; whilst constipation, which may alternate with occasional attacks of diarrhœa, becomes a prominent symptom. In those patients in whom the obstruction within the biliary canal is only partial the fæces retain their normal colour, a condition which also obtains when the obstruction is in the common bile duct, and there is at the same time a fistulous communication between the cavity of the gall bladder and the lumen of the adjacent portion of the alimentary canal. This sequence of events, namely, the occurrence of paroxysmal attacks of biliary colic, followed by the development of jaundice and its accompanying symptoms, is very suggestive and even diagnostic of the presence of biliary calculi. When the calculus becomes impacted in the cystic duct, jaundice does not usually appear, owing to the non-interference with the course of the bile from the liver to the duodenum; but it may happen, when an obstruction of this kind occurs, that pressure is exerted upon the common bile duct from without, and jaundice results. Some authors have attempted to divide cases of cholelithiasis into two main classes, according to the occurrence or non-occurrence of jaundice. This subdivision appears to be very artificial, and as it does not serve any practical purpose it is not adopted. A subdivision of this kind may be of some use in establishing a diagnosis in difficult cases, and on this account it will be referred to again later.

*Temperature.*—It occasionally happens in cases of biliary colic which are associated with the appearance of jaundice, that an ague-like temperature develops which resembles in many respects an attack of so-called urethral fever. In these patients a rigor occurs soon after the termination of an attack of colic, the temperature rises to 103° F. or more, the rigor lasting for a variable length of time, but generally being of short duration. The occurrence of a rigor of this nature is followed by a fall in the body temperature, and the manifestation of symptoms of prostration from which the patient soon recovers, only, however, to suffer at a later period from successive similar attacks. These rigors may occur without the development of jaundice, but they are much more common in those cases in which jaundice is a prominent symptom. As regards the pathology of this condition, little that is definite appears to be known. Some authors such as Charcot[1] have maintained that the fever was due to the absorption of some kind of ferment, which had been produced as the result of the pathological changes occurring in the biliary passages, whilst Murchison[2] and Ord think that it is nervous in character, and is due to irritation of the mucous membrane of the common bile duct by the presence of the calculus. From recent observations which have been made concerning this subject, it appears probable that in most cases of "hepatic fever," occurring in connection with the impaction of a biliary calculus in some portion of the cystic duct or the common bile duct, the intermittent fever is dependent upon a septic condition which follows an ulceration at the seat of impaction, owing to absorption of septic micro-organisms or their chemical products into the blood stream. In some cases the *B. coli commune* has been shown to be present, and in others, either the streptococcus pyogenes or a variety of staphylococcus, and in others a pneumococcus. The staphylococcus was found to be present in the blood of the patient in one case of this kind which was examined by Ortner. Septic endocarditis has been induced in several cases of this nature, and the patient has died. Enlargement of the spleen is not uncommonly met with in these patients, in the later stages. Ortner[1] classifies cases of cholelithiasis into the aseptic variety and the septic variety, placing in the former class those cases of gall stones which are not associated with septic complications, and in the latter those in which septic processes either commence in the gall passages or affect them secondarily. The septic group of cases is much more likely to be followed by severe and even fatal complications than the aseptic ones. When a calculus becomes impacted in the common bile duct, it is most commonly arrested immediately above the ampulla of Vater, which is situated just above the aperture into the duodenum. Two conditions may arise as the result of the arrest of the calculus; either a catarrhal condition of the biliary passages, which has fairly-defined symptoms, with ague-like attacks, rigors, fever, etc., which are intermittent in character and are often repeated, or biliary obstruction which is associated with the development of a suppurative condition of the bile ducts. When this latter condition occurs, the fever is in most cases of a remittent type.

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[1] Charcot, "Leçons sur les maladies du Foie," Paris, 1877.

[2] Murchison, "Lectures on Diseases of Liver," 1888, 3rd edition.

If the hepatic region of a patient who is suffering from cholelithiasis be examined, the liver in some cases is found to be tender to palpation and slightly enlarged, so as to project for a short distance below the right chondral margin; but much more commonly it is possible to feel a localised swelling situated behind the ninth or tenth costal cartilages of the right side. This swelling tends to extend downwards and forwards towards the umbilicus, or along a line which is drawn from the ninth costal cartilage of the right side to a point one-third of the way from the pubic spine, to the anterior-superior iliac spine of the same side. The swelling is smooth and rounded, larger below than above, moves with respiration, descending during each inspiration and ascending during each expiration, and can be moved laterally by pressure with the examining fingers; it is dull to percussion, and on auscultation nothing is audible. In order to palpate the abdominal region, the patient should be directed to lie upon his back, and with the knees in a slightly flexed position. Then he should be told to breathe quietly, and the palpating hand should be laid flat upon the abdominal wall over the hepatic area, and pressure gradually increased, especially at the tips of the fingers. In this manner, if there is any enlargement in the hepatic region, it can in most cases be easily felt. If, however, nothing can be ascertained by this method of examination, the patient may be directed to sit up and bend the body slightly forwards (breathing as before). The hand should now be applied to the hepatic region, and pressure gradually exerted with the fingers. In this way it is often possible to palpate swellings in the region of the gall bladder which cannot otherwise be made out. It is possible in many patients, especially in women with thin and lax abdominal walls, to feel the normal notch in the anterior-inferior border of the liver, at the bottom of which lies the fundus of the non-distended gall bladder. If both these methods fail to detect any abnormal condition, it will then be advisable to anæsthetise the patient and to make an examination of the abdomen. When the gall bladder is the seat of an enlargement in a case of cholelithiasis, the swelling may be due either to a large collection of calculi, which completely fills the organ and distends it beyond its normal size, or to an accumulation of fluid in its interior, which fluid may be the secretion of the liver, that is to say, ordinary bile; or it may be purulent in character, owing to the establishment of a septic process; or, again, it may be due to an accumulation of calculi, together with bile or purulent fluid, or both. If the calculus which is the cause of the enlargement is arrested in the common bile duct, it does not necessarily follow that the gall bladder will become dilated, since in some of these cases it is found that the bile which is secreted accumulates in the common bile duct and the hepatic ducts, and does not pass along the cystic duct to the gall bladder. In these cases the passage of the bile to the gall bladder appears to be prevented by the arrangement of the spiral valve in the interior of the

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[1] Ortner, "Zur Klinik der Cholelithiasis," 1894.

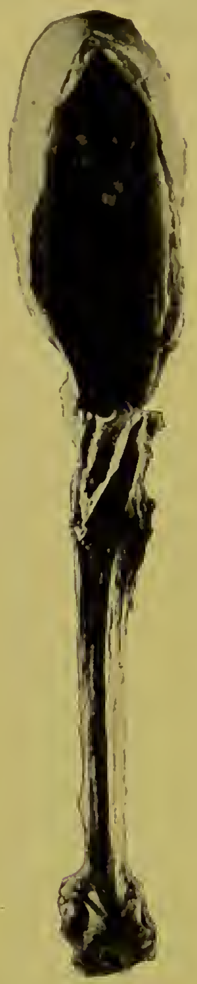

FIG. 31.—Total obliteration of the lumen of the gall bladder by a calculus. A gall bladder, cystic duct, and common bile duct. The cavity of the gall bladder is entirely filled by a large single calculus. The canal of the cystic duct is rather narrow, but that of the common bile duct is dilated.

cystic duct. When a calculus becomes arrested in the cystic duct, and a complete obliteration of the lumen of this canal results, the gall bladder usually becomes enlarged and dilated on account of accumulation of mucus (pseudo-mucus) in its interior. This substance has been secreted by the mucus glands which are found in the mucous membrane lining the gall bladder. In other cases of this kind the mucous membrane of the cystic duct and the impacted calculus form a kind of ball-valve, which allows bile to pass from the cystic duct into the gall bladder, but does not allow the fluid to pass in the reverse direction. When a

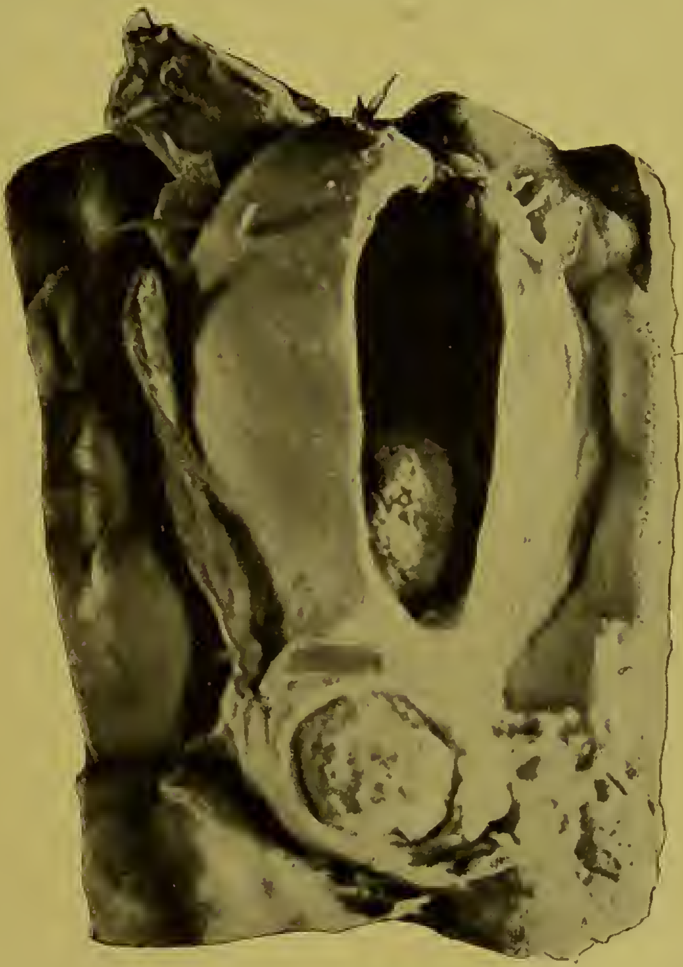

Fig. 32.—Encysted calculus of neck of gall bladder and commencement of cystic duct; portion of liver and gall bladder. The gall bladder is considerably dilated, and contains in its interior a large oval-shaped calculus. The region of the neck of the viscus and the commencement of the cystic duct are dilated, and surrounded by thickened inflammatory tissue. In the interior of this dilated portion there is a large rounded calculus, firmly embedded in the surrounding tissue.

swelling is felt in the abdomen, which is due to an enlargement of the gall bladder, it is attached above, and has the characters which have already been mentioned. The swelling may or may not show signs of fluctuation, according to whether the contents of the distended viscus are solid or fluid; in most cases there is a certain amount of fluid, and it only occasionally happens that the swelling is composed entirely of calculi. When the distended gall bladder is filled with fluid, it is not always possible to obtain definite evidence of fluctuation, owing to the tenseness of the dilated viscus. When there are calculi only, no evidence of fluctuation will be obtainable. It occasionally happens that a large calculus of the gall bladder passes into the lumen of the adjacent portion of the alimentary canal, owing to the formation of a fistulous communication between the two viscera by a process of ulceration, without giving rise to symptoms of biliary colic or any other train of symptoms by which the pathological condition can be diagnosed. This fact must be remembered in considering any case of intestinal obstruction in which the diagnosis is not clear or apparent, and the region of the gall bladder should be examined in order to ascertain whether there are signs to be felt which may be of use in establishing a correct diagnosis. If a gall stone is small enough to pass along the common bile duct into the duodenum, it is very unlikely that it will become a cause of intestinal obstruction.

*Diagnosis.*—The most important symptoms which point to the existence of biliary calculi are the occurrence of paroxysmal attacks of lancinating pains in the abdomen, accompanied by a feeling of sickness, and terminating usually in a fit of vomiting. The pains are most marked in the hypochondriac region, especially the right, and radiate from there downwards towards the umbilical region, and backwards towards the inferior angle of the right scapula. The duration of the attack may be, as we have already seen, a few days or a few hours. When jaundice occurs, it is an important symptom, and usually comes on from twelve to thirty-six hours after the occurrence of the paroxysm of pain. Jaundice does not occur, however, in those cases in which the calculus becomes impacted in the cystic duct, or in which it passes back again into the gall bladder, whilst, if the obstruction in the common bile duct or the hepatic duct is not complete, no jaundice occurs. When jaundice is present, it points, in those cases in which it occurs in connection with an attack of colic, to the existence of an obstruction in the common bile duct or the hepatic duct. The attack of jaundice is variable in intensity and usually transient in its duration. It may, however, be persistent and last for several months, in which case the possibility of the occurrence of carcinoma of the bile ducts or the gall bladder may be suspected, and an attempt should be made to discover its existence. If a case of jaundice last for several years, especially if it has been preceded by transient attacks, it is probable that it is due to an impacted gall stone, or to a condition of fibrous constriction of the common bile duct or some other part of the biliary system, which has resulted from the ulceration caused by an impacted gall stone. If calculi are passed along with the fæces or vomited, and these bodies have the structure and composition of biliary concretions, the diagnosis becomes established. Collapse and exhaustion are symptoms which follow the attacks of pain and vomiting, and if they are severe, they usually indicate the presence of biliary calculi. Biliary colic can in most cases be distinguished from renal colic, which is due to the passage of a calculus along the right ureter, by the fact that in the latter case the pain radiates downwards along the right loin to the region of the pelvis or the thigh, and is associated with the occurrence of symptoms of vesical mischief and pathological conditions of the urine. In the colic which is dependent upon lead poisoning, chronic constipation and a blue line upon the gums point to the nature of the affection, whilst the symptoms usually disappear under the treatment appropriate for this disease. In gastric affections, such as an ulcer of the stomach or dyspepsia, the pain is most intense on the left side of the abdomen, and is accentuated by taking food. The paroxysms of biliary colic, when they occur in relation to a meal, usually come on several hours after food has been taken. In cases of cancer of the head of the pancreas, involving the common bile duct, a tumour can occasionally be felt in the posterior part of the abdominal cavity in the region of the pancreas, which is fixed in position and does not ascend and descend synchronously with the movements of respiration. In these cases persistent jaundice is almost invariably met with. When persistent jaundice is present and is not associated with the occurrence of periodic attacks of pain or rise of temperature, especially if rapid loss of flesh is also present, it is probable that malignant disease of the biliary ducts, the gall bladder, or the liver, is under consideration. Membranous enteritis may give rise to a train of symptoms which, in many respects, are similar to those caused by the presence of biliary calculi. If the fæces are examined in these cases, casts or flakes of false membrane may be discovered, which will serve to indicate the true nature of the affection, and hence enable the surgeon to discriminate between the two diseases. In abscess of the liver the attacks of pain are not so severe as in cases of biliary colic, and they do not occur in paroxysms or radiate over the abdominal area in the same manner or so extensively as is the case in the latter class of affections. The passage of an ascaris (or lumbricoid worm) from the duodenum into the common bile duct gives rise to the appearance of a series of symptoms exactly similar to those due to a severe attack of biliary colic, and cannot usually be distinguished from them; but this condition is usually met with in young people, and at this time of life gall stones are not common, whilst the individual affected may give a history of having, at a previous period, passed one or more of these parasites, either per rectum along with the fæces, or by the mouth during an attack of vomiting. The presence of a hydatid tumour in the liver, which has burst into the hepatic duct or the common bile duct, and the passage along these canals of some of the daughter cysts or portions of the membrane, will give rise to paroxysms of pain resembling those due to the passage of a biliary calculus. This pathological condition may possibly be distinguished by the fact that there have been symptoms of the previous existence of a fluctuating hepatic tumour which has suddenly diminished in size, and by the presence in the fæces of hooklets and portions of the membrane which formed the wall of the parasitic cyst. In order to distinguish a tumour which has arisen in connection with the gall bladder from cases of renal, suprarenal, or ovarian tumour, it may be requisite to apply what has been called "Ziemssen's test." This is carried out by injecting a quantity of air per anum, sufficient to dilate the rectum, the sigmoid flexure, and the colon, and then percussing the region of the tumour. If, as a result of this procedure, the tumour is pushed upwards towards the thorax and the area of marked resonance is below it, then, in all probability, it is either hepatic or in connection with the gall bladder; whilst, if it is pushed downwards and backwards, and the area of increased resonance is above, it becomes very probable that the tumour has no connection with the liver, the gall bladder, or the biliary ducts. Some surgeons have advised that the swelling should be punctured with a small trocar or an aspirating needle, in order to determine the nature of the tumour and the character of its contents if it is fluid. This proceeding is, in most cases, not justifiable, since the aperture of puncture is liable to leak subsequently, and the contents of the swelling escape into the peritoneal cavity and set up a peritonitis which may prove to be fatal. Sounding with a needle, a method which has been recommended, is a very dangerous procedure, and ought never to be resorted to. If it is requisite to explore a swelling which is situated in the region of the gall bladder, and which is probably an enlargement of that viscus, in order to be able to make a diagnosis or to clear up the nature of an obscure case, it is far safer to make a small incision over the swelling, either in the middle line or in the right linea semilunaris just below the ninth costal cartilage, through the anterior abdominal wall, and large enough to admit the finger, and through this to make a digital examination. This can be done without submitting the patient to any serious risk, whilst the surgeon is not working in the dark as is the case when a long exploring needle is being used. When an examination of this kind is being made through a small wound in the anterior abdominal wall, it is advisable to examine first the region of the gall bladder, next the cystic duct and the portal fissure of the liver, then the gastro-hepatic omentum, the region of the duodenum, and the head of the pancreas.

*Complications and sequelæ.*—The presence of biliary calculi in the excretory ducts of the liver may give rise to symptoms which may be used artificially to divide the cases into two main groups. We have already seen that some authors have divided them into groups according to the presence or absence of jaundice, whilst others have divided them according to the presence or absence of septic processes. It is proposed to divide them into two main groups according to the occurrence of paroxysms of biliary colic. It must be remembered, however, that this is a purely artificial division, and is only made for clinical purposes.

In the first group are included all those cases in which calculi are present in the gall bladder, and in which periodical attacks of pain occur, owing to the passage of a stone from the gall bladder into the duodenum. These cases are characterised by the occurrence of attacks of biliary colic, which may be slight or severe and accompanied by sickness and vomiting, but since the calculus does not become impacted in the ducts, jaundice does not occur in most cases. After a calculus has passed along the bile duct to the duodenum, the patient recovers, and no further symptoms develop until another calculus passes along the ducts towards the duodenum. If all the calculi which have been formed in the gall bladder are extruded in this manner, the patient may completely recover from the attack of cholelithiasis, but it often happens that, sooner or later, a larger calculus passes from the gall bladder into the cystic duct, becomes arrested, and then causes symptoms which justify the inclusion of the case in the next group. In some of these cases the gall stone gives rise to an inflammatory condition in the walls of the gall bladder, which persists for some time after the calculus has passed into the duodenum, and is followed by the formation of a number of adhesions between the gall bladder and the adjacent portion of the abdominal wall, or one of the neighbouring abdominal viscera. When these adhesions have been formed, they are liable to cause the appearance of symptoms which resemble to a certain extent those due to the presence of gall stones themselves within the gall bladder. Usually, however, the symptoms which are dependent upon these adhesions are not so severe in character as those which are due to the presence of calculi, and they do not cause attacks of true biliary colic.

In the second group are included the remaining varieties of cases. This group comprises a considerable number of allied pathological conditions, which may be classified as follows, namely—

(*a*) *Cases in which impaction of a calculus takes place in some part of its passage from the gall bladder to the duodenum.*—This impaction may take place in the following situations, namely, (*a*) the neck of the gall bladder; (*b*) some part of the cystic duct; (*c*) in the common bile duct, usually at the ampulla of Vater; (*d*) the hepatic duct, in which case the calculus has passed backwards towards the liver. The nature of the impaction may be such as to give rise to either partial or complete obliteration of the lumen of the duct, and consequently partial or complete obstruction to the flow of bile along the affected portion of the biliary canal. In those cases in which the cystic duct is the seat of the impaction, and the obstruction is complete, the gall bladder usually becomes dilated and distended owing to an accumulation of mucus, which is secreted by the glands lying in the membrane which forms the internal lining of the gall bladder. As a result of this accumulation of mucus the viscus may attain considerable dimensions, and may occupy the greater

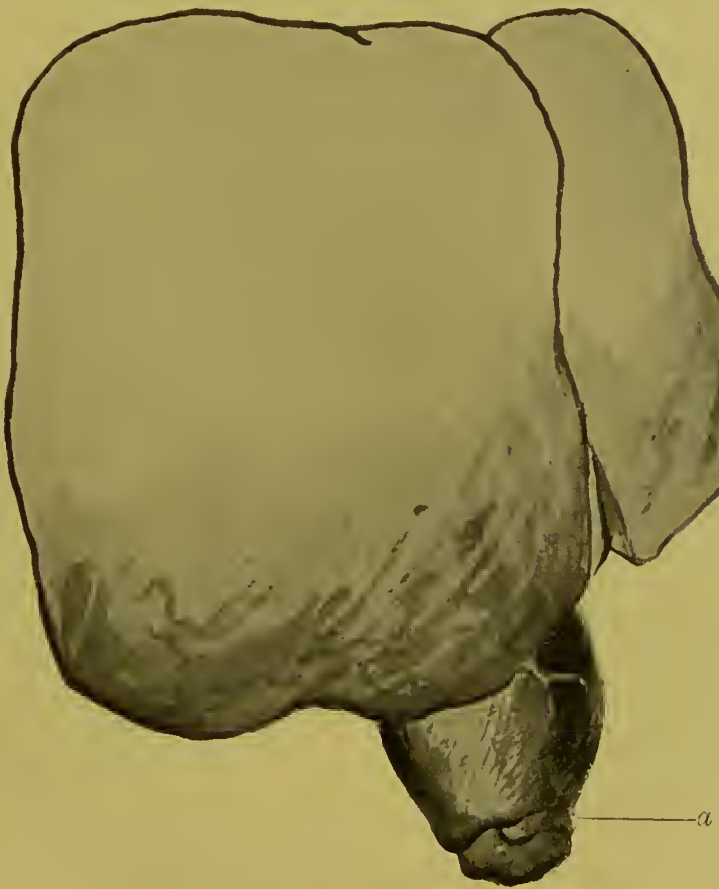

FIG. 33.—Enlarged gall bladder of a woman, the lower extremity of which passed through the right femoral ring and formed the contents of the sac of a right femoral hernia. *a*, part of gall bladder which occupied hernial sac.—*St. Barth. Hosp. Museum.*

part of the cavity of the abdomen. Usually, however, it does not extend beyond the umbilicus. Fig. 33 is an illustration of a gall bladder, the fundus of which occupied the sac of a right femoral hernia. The enlargement of the gall bladder was not discovered until an operation was performed. In these cases the colouring matter which was present in the bile contained within the gall bladder, at the time of the establishment of the obstruction, becomes absorbed, and the contents of the distended organ have the appearance of pure mucoid fluid. If the calculus becomes impacted in the common bile duct, or in the common hepatic duct, and the obstruction is complete, there will be an accumulation of bile in those portions of the bile ducts which are proximal to the seat of impaction, and this will be followed by the development of jaundice. If, however, the obstruction is located in the common bile duct, and owing to a previous process of ulceration, by means of which a calculus has passed from the gall bladder or the cystic duct into the adjacent portion of the alimentary canal, a fistula has been established, then there may be no symptoms beyond those which are due to the irritation caused by the presence of the calculus in the common bile duct. The gall bladder does not usually become dilated in cases of obstruction of the common bile duct, owing to

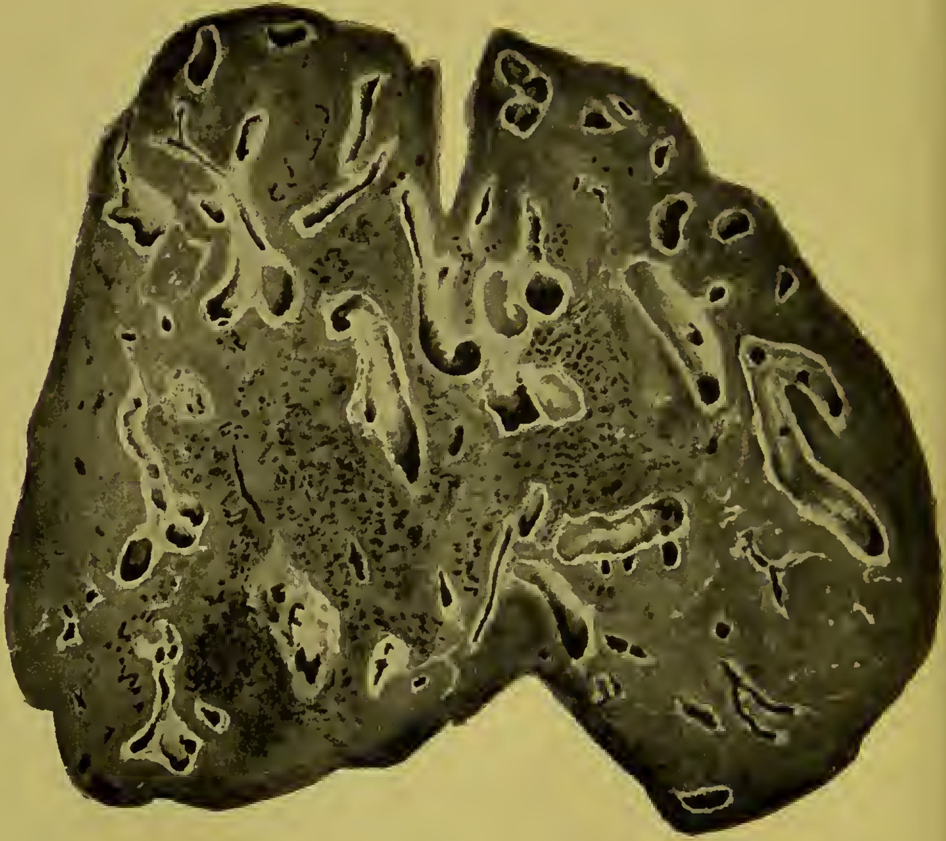

Fig. 34.—Section of a liver showing the intra-hepatic bile ducts enormously dilated, the result of obliteration of the lumen of the common bile duct by a calculus.

the presence of the spiral valve in the interior of the cystic duct, which tends to prevent the easy passage of fluid along it towards the gall bladder when the bile is under a high pressure. When the common hepatic duct is the seat of the impaction of the calculus, the gall bladder never becomes distended, unless a second stone is lodged in the cystic duct.

(*b*) *Cases in which impaction of a calculus occurs in some portion of the bile ducts, and is followed by the development of an infective suppurative inflammation of the mucous membrane which lines the interior of the biliary passages.*—As a result of a septic process of this kind, the following different but closely allied conditions may be induced—(*a*) inflammation of the gall bladder and the bile ducts; (*b*) empyema of the gall bladder; (*c*) hepatic abscess; (*d*) abscesses in the structures which are in the immediate neighbourhood of the gall bladder or bile ducts; (*e*) acute suppurative general peritonitis; (*f*) perforation of the gall bladder or one of the bile ducts, and passage of the gall stone and the inflammatory products into the peritoneal cavity. These cases may be called the septic class, and they are in most instances due to the formation of one or more ulcers of the mucous membrane of that portion of the bile duct in which the calculus is located; subsequently this becomes the seat of a septic process owing to the absorption of some form of suppurative micro-organism which has obtained an entrance into the bile passages from the alimentary canal. The micro-organisms which have been found in cases of this kind are *Streptococcus pyogenes*, *Staphylococcus pyogenes aureus*, *B. coli commune*, and the *Diplococcus pneumoniæ*. When the inflammatory process is limited to the mucous membrane of the bile ducts, a condition of angiocholitis is established, which may extend to the liver and cause the development of a hepatic abscess, or through the walls of the bile canals into the adjacent tissues and give rise to the formation of localised abscesses, or to a general peritonitis. In those cases in which the calculus becomes impacted in the cystic duct, and a septic condition follows, the gall bladder may become distended owing to an accumulation of purulent matter in its interior, a condition which is called empyema of the gall bladder. In other cases the septic process gives rise to ulceration of the biliary passages, especially in the neighbourhood of the impacted calculus; perforation takes place with escape of pus, and the calculus passes either into the peritoneal cavity or into the adjacent tissues. All these cases are characterised by the appearance of changes in the temperature, such as have been described above.

(c) *Ulceration of the walls of the gall bladder or one of the bile ducts, followed by adhesion to a neighbouring portion of the alimentary canal—duodenum, colon, small intestines, stomach—and perforation into the lumen of the gut, with passage of the calculus into the alimentary canal, and the establishment of an internal biliary fistula.*—In many of these cases the symptoms which accompany the passage of a calculus into the alimentary canal are very indefinite, and do not permit of a diagnosis of the pathological condition being made. It happens occasionally that large biliary calculi are passed per anum without being preceded by the occurrence of any symptoms suggestive of the existence of gall stones. In other cases, vague abdominal pains have been noticed. In these cases the fistulæ which are established as the result of inflammatory processes, usually close spontaneously after a short time, if there is no obstruction to the flow of bile along the common bile duct.

(d) *Cases in which intestinal obstruction occurs owing to the impaction of a gall stone in some part of the alimentary canal.*—This condition may be caused by the passage of a calculus into the duodenum through the opening of the common bile duct after this has been dilated, or by the passage of the calculus through an abnormal opening which has been produced by a process of ulceration, such as has been described above. It rarely happens that a gall stone which has passed into the duodenum through the normal opening of the bile duct, causes an obstruction in the intestine, and it may be said that in nearly all cases of obstruction of the intestine which are due to the impaction of a gall stone, the calculus has obtained an entrance into the alimentary canal through an internal biliary fistula which has been induced by a process of ulceration and perforation, preceded by the formation of adhesions between the gall bladder or one of the bile ducts and a portion of the intestine. It is difficult to diagnose a case of intestinal obstruction as being due to this cause, but this subject will be dealt with in greater detail later (Chap. XXIII.).

(e) *Cases in which adhesions are formed between an inflamed gall bladder and the posterior aspect of the adjacent portion of the anterior abdominal wall, which condition is followed by the* *development of an abscess which points on the surface of the body, and may burst spontaneously, discharging pus and gall stones, and leaving an external biliary fistula.*—This condition will be discussed in the chapter on Biliary Fistulæ (Chap. XXII.).

(*f*) *Cases in which inflammation of the gall bladder occurs and is followed by desiccation of the pus and conversion of the gall bladder into a mass of fibrous tissue or into a calcareous nodule.*—This condition is associated with indefinite symptoms, and it is almost impossible to diagnose its existence until an examination of the part is made, either during a surgical operation or post-mortem.

(*g*) *Cases in which a localised ulceration of some part of the mucous membrane lining the bile ducts is produced, owing to the presence of an impacted calculus, which calculus has passed onwards into the duodenum, and this condition of ulceration is followed by cicatrisation of the affected area, and a stricture of the lumen of the duct results.*—From this condition a train of symptoms may arise which are similar to those due to the presence of an impacted calculus, but they come on much more slowly, and are not usually associated with the occurrence of attacks of severe biliary colic. In the early stages of this condition, however, there are symptoms of hepatic colic dependent upon the impaction of a calculus which has been the cause of the ulceration. The jaundice which results from an obstruction of this kind may develop more slowly than in cases of impaction of a calculus, but this is a distinction upon which little reliance can be placed, since the jaundice which is due to the obstruction caused by the calculus may run into that due to the stricture.

(*h*) *Cases in which the continued irritation of the mucous membrane of the gall bladder, or some portion of the biliary ducts, is succeeded by the development of a carcinomatous affection which may involve either the gall bladder or one of the bile ducts.*—The symptoms associated with these conditions are given in the chapters on malignant disease of the biliary system. Some authors think that most cases of cancer of the gall bladder or the bile ducts are due to the irritation which is produced by the presence of calculi, whilst others maintain that the gall stones are due to the presence of the cancerous affection. Riedel[1] of Jena has recently described an inflammatory condition

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[1] Riedel, *Berl. klin. Wchnschr*, 1896, Nos. 1 and 2.

of that portion of the pancreas adjacent to the lower part of the common bile duct, which he thinks is dependent upon or caused by the irritation due to the presence of one or more gall stones in the common bile duct, especially in the ampulla of Vater, or the opening of the duct into the duodenum. The calculus apparently first establishes an inflammatory condition of the wall of that portion of the duct in which it lies, and then this inflammation spreads to the pancreas by direct extension, a process which is rendered easy by the circumstance that in a number of cases the lower segment of the common bile duct perforates the substance of the head of the pancreas in its course to the second part of the duodenum. The inflammation gives rise to an interstitial infiltration of the affected portion of the gland, and results in the formation of hard nodules or masses of fibrous tissue which have undergone contraction. It occasionally happens in this class of case that the head of the pancreas becomes generally enlarged, and acquires appearances which are suggestive of carcinoma. An inflammation of the head of the pancreas may be met with in cholelithiasis, when no trace of the presence of calculi can be found in the lower segment of the common bile duct. It is probable, when this condition occurs, that a calculus has been arrested in the region of the ampulla of Vater, and, having caused an inflammation, has then passed onwards into the duodenum and been evacuated with the fæces. Riedel has recorded three cases of pancreatitis due to cholelithiasis, which he submitted to operation; two recovered, and one terminated fatally.

*Treatment.*—The treatment of cases of cholelithiasis has to be considered under two distinct headings—(*a*) medical and general therapeutical measures; and (*b*) operative procedures. (*a*) The indications for the adoption of a course of medical treatment differ according to whether the patient is suffering from a paroxysm of biliary colic, or whether he is seen during a quiescent interval. In the former case it is essential that an attempt should be made to relieve the pain and to induce the calculus to pass onwards into the duodenum. When the patient is suffering from an attack of colic, placing the sufferer in a hot bath, or the application of hot fomentations to the hepatic region, may afford temporary benefit, and also by causing a relaxation of the tissues may facilitate the onward passage of the calculus into the duodenum. In many cases it is found that a subcutaneous injection of $\frac{1}{4}$ gr. of hydrochlorate of morphine affords considerable relief. It may be requisite to repeat this dose. Some authors have objected to the use of morphine, since they say that it causes a diminution in the amount of bile which is secreted by the liver; this objection, however, can be got over by combining the morphia with $\frac{1}{120}$ gr. of sulphate of atrophine. When there is no vomiting it may be advisable to give morphia by the mouth. If the paroxysm of colic is very severe, and does not yield to any of the above measures, it is advised that the inhalation of chloroform should be tried. Burney Yeo[1] recommends the administration by the mouth of large quantities of warm water, in which a small quantity of sodium bicarbonate and sodium salicylate has been dissolved. He says that this is especially useful when morphia has been given, since it increases the flow of the bile, and hence helps to expel the calculus along the bile ducts which have been relaxed by the morphine. Olive oil has been given with the object of relieving an attack of biliary colic and also of preventing the recurrence of these attacks. The amount of oil which has been given for a dose has varied between 5 and 12 ounces. Willemin[2] and Sée[3] have reported cases which have apparently derived considerable benefit from this method of treatment. Other observers have, however, failed to obtain any good results from the employment of this remedial agent. Glycerine, in doses of a half to one ounce, has been given by Ferrand,[4] and he declares that it has given good results. When a paroxysm has passed off, rest in bed should be combined with the application of warmth and the internal administration of some stimulant, such as brandy, ether, or strychnine, in order to restore the patient from the state of collapse and exhaustion which follows the attack of pain. The removal, absorption, and solution of gall stones which are already present appears to be almost impossible by therapeutic measures. Some authorities have advised the internal administration of belladonna, podophyllin, or olive oil, as remedies which will cure gall stones. There is, however, very little evidence of the value of these drugs. If there are only a few small calculi present in the gall bladder, they may possibly be passed spontaneously or with the aid of the drugs mentioned above. Courses of mineral waters, especially those of Carlsbad, in many instances appear to have facilitated the expulsion of gall stones. The water of Carlsbad is a purgative and a cholagogue, and it tends to cause a relaxation of the walls of the bile ducts, and at the same time increases the flow of bile. It often happens in patients who are suffering from cholelithiasis, and who undergo the course of treatment at Carlsbad, that a few days after the commencement of the treatment an attack of biliary colic occurs, owing to the passage of a gall stone into the bile ducts. Other waters have also been recommended, such as Wiesbaden, Ems, Vichy, Marienbad, Neuenahr, Kissingen, and Homburg, but most of these do not appear to be so efficacious as those of Carlsbad. A course of treatment which is similar to that of Carlsbad may be carried out at home, if the patient will take the imported Carlsbad water and carry out the directions for the mode of living.

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[1] Burney Yeo, "Manual of Therapeutics," 1895, vol. ii.
[2] Willemin, "Des coliques hépatiques," Paris, 1891.
[3] Sée, "Médicaments cholagogues," *Med. mod.*, Paris, Jan. 23, 1890, p. 88.
[4] Ferrand, *Semaine méd.*, Paris, March 9, 1892, p. 96.

The formation of gall stones may be prevented in great measure by attention to the diet, exercise, and the general hygienic condition of the patient. A moderate amount of alcohol only should be allowed, whilst all indigestible foods should be strictly forbidden. The bowels should be kept freely open by the administration of alkalies and aloes; Carlsbad salts or sodium sulphate being also used for this purpose. A fair amount of gentle physical exercise should also be enforced, and if the patient be a woman attention should be paid to tight-fitting corsets or any form of dress which may press upon the hepatic region and impede the normal free movements of respiration. Massage of the abdomen has been recommended as a measure which facilitates the expulsion of calculi from the gall bladder or the biliary ducts. This is not to be advised, owing to the uncertainty of its effects and to the fact that ulceration or perforation of the walls of the gall bladder or of the bile ducts may be and has been induced. All the above measures, however, can only be regarded as palliative or preventative methods of treatment; and in a considerable number of patients it is necessary, in order to cure the patient of the diseased condition which is dependent upon the cholelithiasis, to have recourse to direct surgical operative interference. The signs and symptoms which point to the necessity of surgical interference in a patient who is suffering from cholelithiasis are—(*a*) the presence of a tumour in the abdomen, which appears to be an abnormally distended and large gall bladder; (*b*) the existence of jaundice which is persistent, together with other signs and symptoms which point to complete obstruction of the common bile duct or the common hepatic duct; (*c*) the occurrence of successive paroxysmal attacks of biliary colic, with short intervals between the individual attacks, which are lowering the general health of the patient, inducing a state of general exhaustion, and are not amenable to medical measures; (*d*) symptoms of localised inflammation in the region of the gall bladder, which are associated with the occurrence of attacks of biliary colic; (*e*) the occurrence of acute peritonitis, which is probably due to perforation of the gall bladder or of one of the biliary ducts, and escape of calculi and purulent matter into the peritoneal cavity. When the performance of an operation has been decided upon, it is not always possible to say what is the best thing to be done until the abdomen has been opened, and a careful examination has been made of the abnormal conditions which are present. The objects of the operation, however, may be said to be the removal of the biliary calculi, the relief of any form of obstruction which is present in the course of the bile canals, and the re-establishment of the bile channel, the evacuation of any collection of purulent matter which may have formed, and the relief of any complications which have developed as the result of the affection of the biliary system. It will thus be seen that a considerable number of surgical procedures require discussion. In all cases it is necessary, when an operation has to be performed, to open the abdomen by an incision in the anterior abdominal wall, and every operation must be carried out under the strictest aseptic precautions, so as to avoid the possibility of the infection of the peritoneum or any other anatomical structure in the area of the operation. In most cases it is advisable to make the abdominal incision in the right linea semilunaris, commencing immediately below the costal margin; but in some cases, especially those in which the calculus is impacted in the lower portion of the common bile duct, it is better to open the abdomen by an incision in the linea alba above the umbilicus.

Some surgeons advise an incision which is parallel with the right costal margin, but, according to my experience, very little advantage is gained by this method. If, after the abdomen has been opened, the gall bladder is found to be the seat of calculi, the viscus should be brought into the abdominal wound, an incision made in its fundus, and the contents removed. The details of this operation, which is known as cholecystotomy, are discussed in Chapters XXV. and XXVI., where also will be found the methods of performing all other operations which are referred to in the succeeding portions of this chapter. In every case of cholecystotomy, after the calculi have been removed from the cavity, a routine digital and visual examination of the entire course of the bile ducts should be made, if possible, so that if any stones are situated in the course of these canals they may be discovered and removed. When a calculus is found to be impacted in the cystic duct, an attempt should first be made to manipulate it backwards into the cavity of the gall bladder, from which it can be removed through the incision in the fundus. If this cannot be done without severely damaging the duct or causing a rupture of its walls, an attempt should next be made to break it up into fragments, either by crushing it between the fingers or with padded forceps, or by needling it with a strong steel needle, which is introduced into the stone, either along the course of the cystic duct from the gall bladder or by piercing the walls of the cystic duct in the proximity of the stone, care being taken not to pass through any part of the cystic duct which is distended and thinned by the presence of the calculus in its interior. Some authors have advised that an attempt should be made to dissolve the stone by ether, but this suggestion does not appear to be a practicable one. When the calculus has been broken up by one of these methods, the fragments are forced along the cystic duct into the gall bladder, from which they are removed. In a certain number of cases it is found to be impossible to extract the stone by any of the above methods, and then it is necessary to incise the cystic duct and to remove the calculus through the incision. The former operation of crushing has been called cholecystico-lithotrity, and the latter incision cystico-lithotomy. When the calculus has become impacted in the common bile duct, an attempt may first be made either to manipulate the stone backwards into the gall bladder or onwards into the duodenum. If these manipulations fail, crushing, needling, or incision of the wall of the common bile duct, must be resorted to. These operations are known as choledocholithotrity and choledochotomy respectively. It has happened that a calculus has become impacted at the entrance of the common bile duct into the duodenum, and it has been found to be impossible to extract the stone by any of the above methods. For these cases Kocher[1] has performed an operation which he designates "internal choledocho-duodenostomy." In this operation a transverse incision is made in the anterior wall of the second portion of the duodenum, and the aperture of the common bile duct incised or dilated from within, and the stone extracted from the lumen of the bowel. Terrier[2] of Paris has proposed the performance of a lumbar operation, through which a calculus impacted in the lower portion of the common bile duct can be removed. The difficulties in the performance of this operation appear to be so considerable that its adoption is not recommended. After the calculus has been removed from the cystic duct or the common bile duct, by an incision in its wall, the margins of the incision should be approximated and united by the introduction of fine silk sutures, a double tier being introduced, if possible. In most cases of this kind it is advisable to leave open a small part of the abdominal wound, and to pass a tampon of gauze down to the site of the incised duct, so that if any leakage takes place it may be recognised, and the fluid may escape externally. When the gall bladder has been incised, it is necessary, in most cases, to unite the margins of the wound in the viscus to those of the abdominal incision, and only rarely can the organ be sewn up and then dropped back into the abdominal cavity. The only conditions under which this latter proceeding is justifiable appear to be when the gall bladder is in a perfectly healthy condition, and contains a few small calculi, which can be extracted through a small aperture. This operation has been called "cholecystendysis," or "ideal cholecystotomy." When a perforation of the gall bladder or one of the bile ducts has occurred, and septic peritonitis has been set up, the peritoneal cavity must be thoroughly washed out, so as to remove, as far as possible, all infective matter; and if the perforation is situated in the region of the fundus of the gall bladder, its margins must be united to those of the abdominal incision, and the cavity of the viscus drained; whilst, if the perforation is situated in the neck of the gall bladder, or in the cystic duct, the entire gall bladder and the involved portion of the cystic duct must be removed by the performance of cholecystectomy. When the perforation involves the common bile duct, an attempt should be made to close it with sutures after it has been rendered as aseptic as possible, and a drainage tube or gauze tampon passed down to the region of the sutured duct and brought out of the abdominal wound.

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[1] Kocher, *Cor.-Bl. f. schweiz. Aerzte*, Basel, April 1895.

[2] Terrier, *Rev. de chir.*, Paris, 1896.

*Prognosis.*—The prognosis in cases of cholelithiasis is in many cases good. During recent years the advances which have been made in the surgical treatment of diseases of the liver and biliary system have considerably lessened the rate of mortality from the various complications which are liable to arise as the result of the presence of biliary calculi. In septic and inflammatory cases in which there is a perforation into the peritoneal cavity, the prognosis is the worst; but even in these cases, if radical surgical treatment is immediately adopted, there is a chance of the patient's recovery. The dangers and the complications which may result from the performance of the different surgical operations are discussed in connection with the description of the operations themselves, and the main indications are also given as to which variety of operation is advisable for any individual case.

# CHAPTER XIX.

## NEOPLASMS OF THE GALL BLADDER.

New growths which have their commencement in one of the histological elements which form the walls of the gall bladder, occasionally occur, but they are not common. They may be either benign or malignant in character, usually the latter; in fact, non-malignant growths of this viscus have only been seen by very few observers.

Benign Growths.—These affections are exceedingly rare, only a few well-authenticated cases can be found to have been recorded by trustworthy observers. Albers[1] has described and figured a case of fibroma of the gall bladder, which apparently took its origin from the fibrous tissue which makes up the greater part of the submucous layer. Riedel has recorded a case of non-malignant papilloma of the fundus of the gall bladder, which had been diagnosed as a carcinomatous affection. Wiedemann has met with a case of encysted swelling of the mucous membrane, and Schüppel[2] has given details of a case in which the tumour was a form of papilloma, the newly formed tissue having undergone a myxomatous degeneration. In the clinical and post-mortem records of St. Bartholomew's Hospital for the past ten years (1886–1895), I have been unable to find any evidence of the occurrence of any variety of non-malignant tumour of the gall bladder. Guy's[3] Hospital Museum contains two specimens of simple papillomatous growths of the gall bladder. These growths appear to be of the nature of small multiple fibrous tumours, the surface of each being covered with normal epithelium. When these rare forms of growth are met with, they may be found to be attached to any part of the walls of the gall bladder, and when they grow from the mucous membrane in the region of the point of exit of the cystic duct, they may overlap the internal orifice of this duct, and cause an obstruction to the outflow of the contents of the gall bladder, whilst they allow the ingress of bile from the cystic duct, and thus act after the manner of a ball valve. Hence it is possible that a tumour of this kind might become the cause of a distension of the gall bladder with bile, and so lead to the appearance of an abdominal swelling. The mucous membrane in the neighbourhood of the tumour may be irritated by it in a mechanical manner, and become the seat of an ulcerative process, which may cause a distension of the gall bladder with purulent matter, or even give rise to a perforation of the wall of the viscus, in which event the purulent matter collected within will pass through the aperture so formed into the peritoneal cavity and become the exciting cause of an attack of acute septic peritonitis. In most cases of tumour of this kind no definite symptoms have become apparent, the growth remaining in a quiescent condition.

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[1] Albers, "Fibroma of the Biliary Vesicle," "Atlas der Path. Anat.," Plate xxxviii. Figs. 3 and 4.

[2] Schüppel, "Ziemssen's Handbuch," Bd. vii.

[3] Guy's Hosp. Museum Specs., 1404 and 1405.

*Symptoms.*—These growths in the majority of instances give rise to no definite train of symptoms, especially in the early stages of their development. When they are situated in the region of the neck of the gall bladder they may cause obstruction to the egress of fluid from this sac, and so give rise to the development of an abdominal tumour, which is located in the right hypochondriac region, and has all the characteristics of a distended gall bladder. In those cases in which the mucous membrane of the gall bladder becomes the seat of an ulcerative process, owing to the mechanical irritation of the tumour and to the subsequent septic infection of the biliary passages, symptoms of cholecystitis will be established, and if perforation into the peritoneum occur, there will be signs of acute peritonitis. Usually, however, these tumours are only discovered in the course of a post-mortem examination. It is possible that, in very rare cases, they may be an exciting or predisposing cause in the formation of gall stones in the gall bladder.

*Diagnosis.*—This is impossible under ordinary circumstances, and it can only be made with certainty when the interior of the gall bladder is examined during the course of a cholecystotomy. A tumour of this kind, if present, will be found as a small pedunculated body, attached to some portion of the mucous membrane lining the internal aspect of the viscus.

*Treatment.*—No treatment is called for unless the gall bladder becomes distended owing to an accumulation of bile, mucus, or pus, in which case an exploratory cholecystotomy will be indicated. When a localised growth is discovered, after the abdomen has been opened and the interior of the gall bladder examined, it may sometimes be found possible to remove it locally by applying a silk ligature to its base and excising the part of the swelling which is distal to the ligature. It is advisable, in most cases of this kind, to perform a complete cholecystectomy, since it is quite conceivable that these growths may be the precursors of tumours which are malignant in character. In some cases of tumour of the gall bladder a malignant growth in the early stages of its development may have the external characteristics of a non-malignant tumour, and on this account the growth should not be diagnosed as non-malignant until a microscopic examination of the removed tissue has been made. Small hydatid tumours of the liver, in a few cases which have been seen, have projected into the lumen of the gall bladder, and have given rise to the supposition that a simple form of tumour was being dealt with. When peritonitis has developed, as the result of perforation, it must be treated in the usual manner.

*Prognosis.*—The prognosis of cases of benign tumour of the gall bladder is very favourable if the gall bladder has not become the seat of an ulcerative process which has caused perforation and septic peritonitis. The prognosis is very serious if the latter complication occur.

MALIGNANT GROWTHS.—Malignant new growths of the gall bladder which are primary in character, are derived either from the epithelial elements of the mucous lining, or from the fibrous and muscular tissues which form the outer layers of the wall of the viscus. In the former case they are of the nature of carcinomata, and in the latter of sarcomata. Those new formations which commence in the lining epithelial membrane have the structure of columnar-celled carcinomata, and those which arise in connection with the epithelium of the mucous glands are spheroidal-celled or glandular carcinomata. Usually these growths have the characteristics of scirrhous carcinomata, on account of the large amount of fibrous tissue which binds together the carcinomatous elements. In rare cases the cancers may be medullary in nature, owing to the preponderance of the cellular elements, or they may undergo colloid degeneration. Sarcomata of the gall bladder when they occur may be round-celled, spindle-celled, or mixed-celled. They are exceedingly rare, but they have been met with and recorded by a few surgical observers. Czerny and Riedel[1] have published cases of this nature. I have examined a considerable number of malignant growths of the gall bladder, and have not met with one in which a sarcomatous growth was primary in that viscus. In one case a growth from the liver encroached upon the cavity of the gall bladder and appeared to be a primary sarcoma starting in the walls of the organ. Careful search, however, showed that it was a secondary deposit, which had resulted from the presence of a primary growth elsewhere.

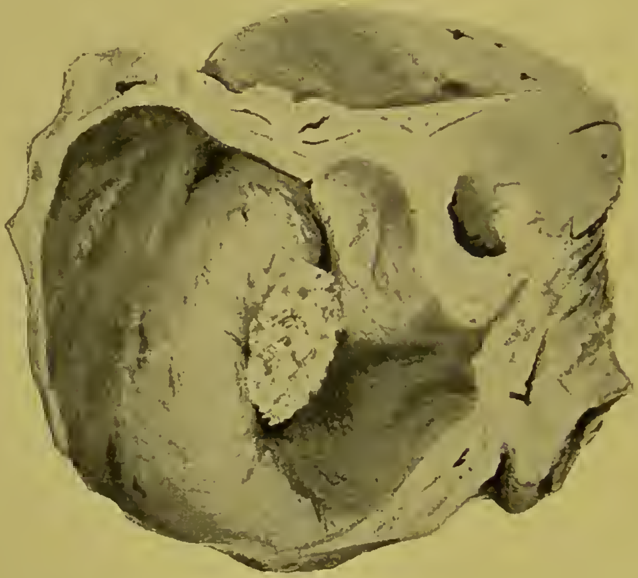

Fig. 35.—Carcinoma of the gall bladder. A localised papillomatous growth from the mucous membrane of the interior of the gall bladder. Microscopically this neoplasm had the structure of a scirrhous carcinoma.—*St. Barth. Hosp. Museum.*

Nearly all primary malignant new growths of the gall bladder will be found to have the structure of carcinomata. When these forms of malignant disease occur, the growth may be localised to a small area in the wall of the organ and project into the interior of the sac, as is the case in the specimens from which Figs. 35 and 36 were taken; or it may involve the whole of the wall of the gall bladder and give rise to the formation of a large swelling or tumour, in the interior of which a number of gall stones may be located. This was the condition of affairs in the patient from whom the gall bladder depicted in Fig. 37 was obtained. In the great majority of cases of carcinoma of the gall bladder, gall stones are found to be present in the interior of the growth. Some authorities upon pathology regard the presence of gall stones in the gall bladder as the causative agent in the production of the disease, whilst others maintain that the formation of gall stones is induced by the presence of the new growth. It has been found in a considerable number of cases of carcinoma of the gall bladder, that the patients so affected give a distinct history of having suffered from gall stones for some time before the appearance of symptoms dependent upon the existence of malignant disease. Thus it is not uncommon to find that a patient who is suffering from a carcinoma of the gall bladder has had for many years, at intervals, attacks of biliary or hepatic colic, or of intermittent pains in the right hypochondriac region. In more than ninety per cent. of cases of carcinoma of the gall bladder which have been examined post-mortem, gall stones have been found to be present, and in nearly all these cases the calculi have been composed of cholesterin or bile pigments. These facts are in favour of the correctness of the view that gall stones are the causative agent in the production of carcinoma of the gall bladder, or at least that the gall bladder has for a long time been the seat of gall stones before the signs of a malignant growth have become manifest. According to the present state of pathological science, constant irritation is said to be frequently the

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[1] Riedel, "Erfahrungen der Gallenstein-krankheiten," 1892.

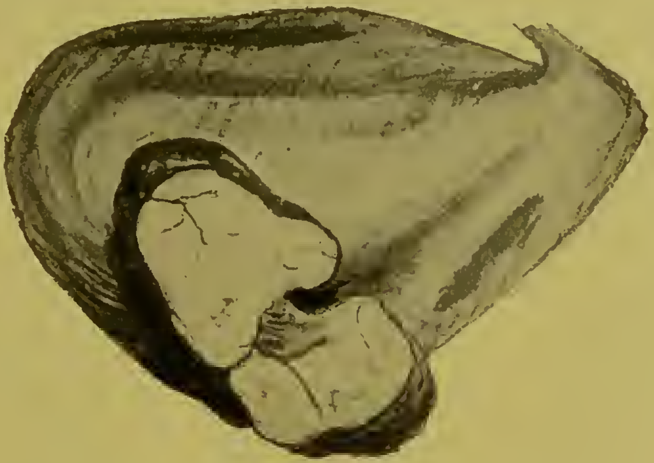

FIG. 36.—Carcinoma of the gall bladder. A gall bladder exhibiting a small localised growth of soft cancer from its lining membrane. Except at the seat of growth, the organ appears to be healthy.—*St. Barth. Hosp. Museum.*

inducing or exciting cause of a tissue taking on a malignant form of growth. If, however, we take into consideration the fact that a large number of people in whose gall bladders gall stones are found to be present after death, do not exhibit any signs of the development of a carcinomatous form of growth, it is difficult to accept the statement that the presence of gall stones in the gall bladder is the sole cause of the epithelial cells which form the lining membrane taking on or assuming a malignant form of growth. In all probability there is some other condition, either

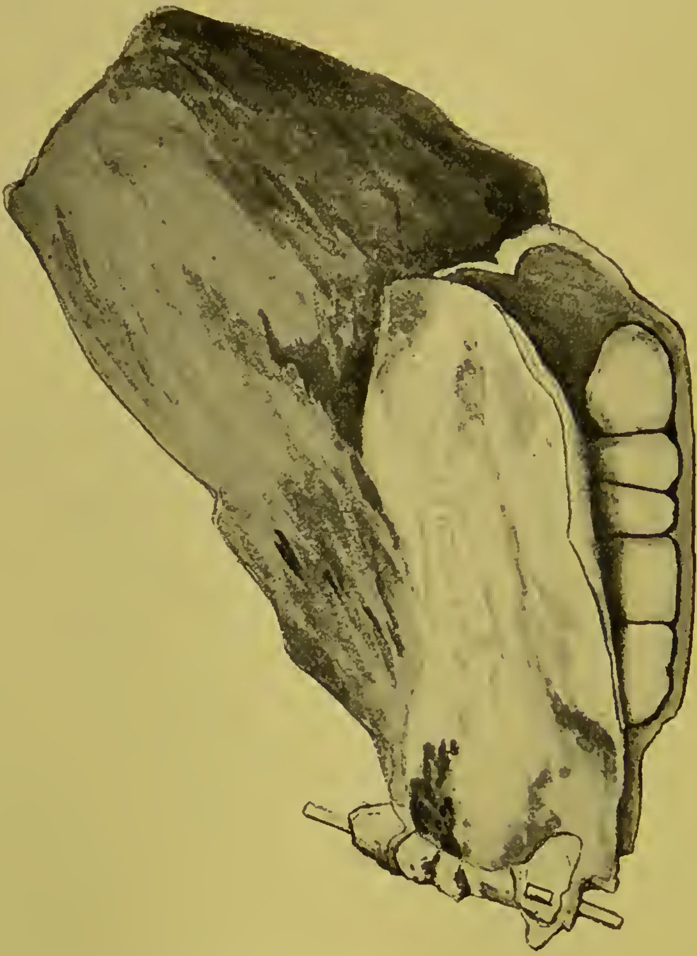

Fig. 37.—Carcinoma of the gall bladder. A gall bladder, the wall of which is converted into a mass of medullary carcinoma; it contains a number of facected gall stones. The growth around the gall bladder was continuous with a mass of infiltrated lumbar glands. The duodenum was compressed, and its walls infiltrated with growth. The neoplasm has the structure of a columnar-celled carcinoma. The specimen was obtained from a woman, æt. 59, who had had an abdominal swelling for five years, but no inconvenience arose from it until about one month before death.—*St. Barth. Hosp. Museum.*

local or general, which, together with the presence of gall stones in the gall bladder, is necessary for the development of a carcinomatous form of growth. Many attempts have been made to show that certain forms of parasites (sporozoa) play an important rôle in the causation of carcinoma, but the evidence upon which these theories have been based appears to be very meagre and insufficient. We have already mentioned that, in most cases of malignant disease of the gall bladder, the calculi which are present consist of cholesterin and bile pigments, and on this account it appears clear that in these cases the calculi must have been present before the development of the carcinomatous process, or at least before this process had advanced to the stage of ulceration. In a small percentage of cases it is found that the calculi consist of compounds of calcium and phosphates, and in these it is possible or even probable that the gall stones have been formed after the commencement of the carcinomatous growth. In this connection, however, it must be remembered that the gall bladder may have been the seat of an inflammatory process previous to the commencement of the development of the carcinoma, and that this condition may have been the cause of the formation of calculi which consist of calcium compounds and phosphates. In from 6 to 10 per cent. of the cases which have been examined, there has been no evidence that biliary calculi have been present in the gall bladder. It is quite possible, in this class of case, that in the early stages of the affection gall stones have been present in the gall bladder, but that they have either become disintegrated and passed as detritus, or that they have traversed the gall passages and obtained an entrance into the alimentary canal, whence they have been extruded per anum, without giving rise to the appearance of any symptoms by which their existence has been recognised or suspected.

*Symptoms.*—In the early stages of carcinomatous affections of the gall bladder there are in most cases no symptoms which can be said to be pathognomonic of the disease. The early symptoms are very obscure in nearly all cases. Often when the patients are closely questioned concerning the early stages of their disease, they will give a history of the occurrence of vague and indefinite pains in the abdomen, which may have been localised in the right hypochondriac region, or of severe attacks of pain which resemble the paroxysms of hepatic or biliary colic. In other cases attacks of diarrhœa, alternating with constipation, have been marked symptoms at the commencement of the disease. Occasionally, symptoms of gastric disturbance or attacks of vomiting have been the predominant external manifestations of the affection. In one of the cases described by Markham the vomit contained some blood-stained matter. The hepatic region is often painful on palpation, but in many cases no tenderness of this area of the abdomen is apparent. Jaundice has been said to occur in 70 per cent. of cases, but in the early stages of the disease it is usually absent.

When the affection has become well established, and the tumour has extended to the bile ducts in the portal fissure of the liver or in the gastro-hepatic omentum, the occurrence of jaundice is very common ; the discoloration may be only slight in amount, or it may gradually increase in intensity until the skin is of a dark greenish-yellow colour. The development of jaundice is due to the extension of the new growth to one or other of the bile ducts, or to the lumen of the ducts becoming obliterated by pressure from without, or by the pressure from enlarged lymphatic glands in the portal fissure of the liver and gastro-hepatic omentum, or by impacted calculi and inflammatory processes which involve the mucous membrane of the large bile ducts. In the later stages of the affection pain is a frequent symptom, and is localised chiefly in the right hypochondriac region, or in the epigastrium, whence it may radiate towards the umbilicus or to the inferior angle of the right scapula. The pain is variable in character; in one class of case it is present as a constant gnawing pain which is localised for the most part to the upper and right side of the abdomen, and in another class it comes on in paroxysms of severe lancinating pains, which may last for several minutes or even hours. In the latter variety of case the attacks of pain very much resemble those of hepatic colic, which are due to the presence of biliary calculi in the bile ducts. In those cases in which the right hypochondrium is the seat of a local tenderness, this is increased during an attack of pain. Clinically, carcinoma of the gall bladder may be said to present two main forms in the later stages. In the first class may be included those cases which resemble in many respects a case of carcinoma of the liver (Fig. 38), whilst in the other class are placed those cases in which the main symptoms are those of chronic jaundice, with retention of the bile (Fig. 39). In both classes, however, a tumour can usually be discovered in the abdomen, which is hard, solid, and situated in the right hypochondriac region, extending downwards to the umbilicus, or even into the right inguinal region when the tumour has attained very large dimensions. In most cases the swelling is small and rounded or ovoid in shape, but it may attain a diameter of several inches. It is fixed above to the inferior border of the liver, and part of the tumour may be situated in the liver itself, owing to a direct extension of the growth in that direction. The margin of the tumour is quite distinct below, but above it cannot be separated from its connections with the lower border of the liver. It moves upwards and downwards synchronously with the movements of respiration. In nearly every case the tumour appears to be quite hard and solid on palpation, and it does not give the smooth and elastic feeling which is constantly met with when the gall bladder is enlarged on account of gall-stone obstruction and distension with bile or pus. In the later stages it is not uncommon to find that the gall bladder becomes the seat of suppuration, and an abscess is developed in connection with the cancerous growth which extends

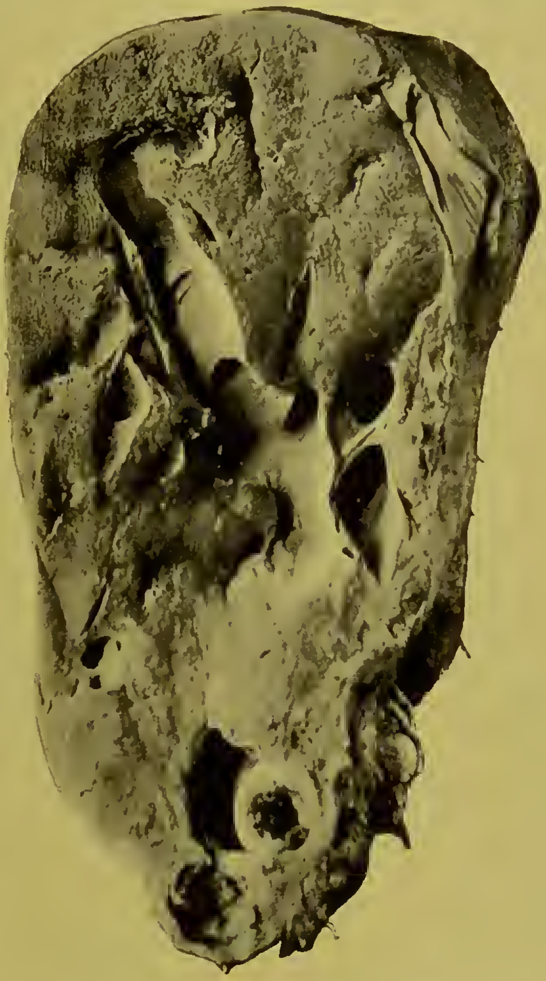

Fig. 38.—Carcinoma of the gall bladder (cubical-celled). Section through the liver and gall bladder of a man, æt. 53. The gall bladder is greatly diminished in size, and contains a calculus ; its walls are thickened and infiltrated with a malignant growth, which spreads into the adjoining liver tissue in all directions for about $1\frac{1}{2}$ to $2\frac{1}{2}$ in. At the time of the post-mortem examination the shrivelled gall bladder contained a thin, milky, mucoid fluid. The bile ducts (intra-hepatic) are enormously distended, and contained a thin yellow fluid. The liver was deeply jaundiced. Microscopically, the new growth consisted of fibrous tissue and alveoli, lined with cubical-celled epithelium.—*St. Barth. Hosp. Museum.*

towards the surface through the overlying abdominal walls. I have recently seen three cases in which this complication has occurred a considerable length of time after symptoms of a carcinomatous affection have become apparent. The surface of the tumour is usually somewhat irregular, and presents a distinct bossed outline, owing to the presence of elevations upon its surface. Wasting and loss of body weight are generally very apparent symptoms, especially in the later stages of the disease, but in some instances which have been placed on

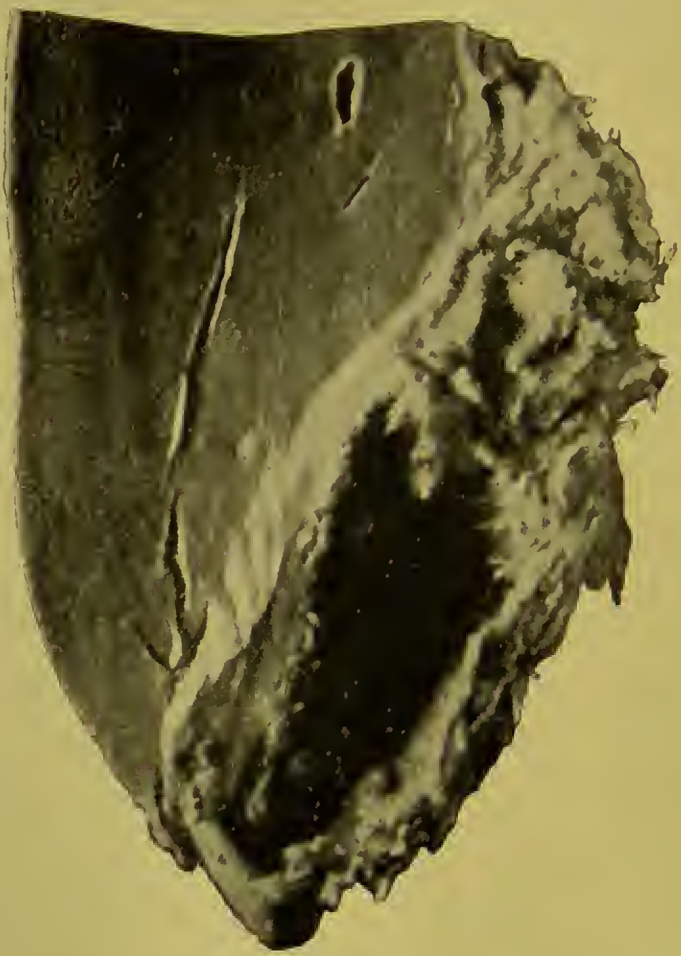

FIG. 39.—Carcinoma of the gall bladder. A portion of the liver with half the gall bladder attached to it. The wall of the gall bladder is considerably thickened, and its internal aspect ragged and shaggy. The entire walls of the organ are in a cancerous condition (columnar-celled carcinoma). The growth had extended into the cystic duct and the tissues around, so as to block the common hepatic duct. The liver was jaundiced, but was free from secondary growths. The lumbar glands contained secondary deposits. —*St. Barth. Hosp. Museum.*

record this condition does not seem to have been of constant occurrence. Diminution of the appetite, with symptoms of gastro-intestinal disturbance, in most cases precede and accompany the wasting and emaciation. Spontaneous hæmorrhages, which are either submucous, subcutaneous, or into the serous cavities, have occasionally been observed. When the portal vein is pressed upon from without by the tumour, or the growth infiltrates its walls and partially obliterates its lumen, ascites and œdematous swelling of the lower extremities occur. Nausea and vomiting are met with, and in these cases the vomiting is said to be due to the direct pressure of the growth upon the duodenum. When the large extra-hepatic bile ducts are obstructed, the liver becomes generally enlarged, owing to the retention of the biliary secretion, and the organ can be felt to extend for a variable distance below the costal margin. In these cases jaundice is invariably present; it increases in intensity and is associated with the occurrence of constipation and absence of colouring matter in the stools. In a few cases diarrhœa has been noticed, which may alternate with periods of constipation. In the late stages of the disease the symptoms of cancerous cachexia become well developed.

*Sex.*—Females are very much more liable to become the subjects of carcinomatous disease of the gall bladder than males. In Courvoisier's[1] list of ninety-eight cases, seventy-five were of the female sex and twenty-three of the male. Statistics which have been collected with reference to this point show that three to five women are attacked to one male.

Siegert[2] has collected all cases of carcinoma of the gall bladder which have been recorded in medical literature up to 1891. He finds that one hundred and one cases had been published. Of these, fourteen were males, seventy-nine were females, and the sex of eight could not be ascertained. Eighty-seven of these cases had calculi within the carcinomatous gall bladder, in seven no gall stones could be found, and in seven the presence or absence was not stated. Out of thirteen cases in which the gall bladder was involved in a secondary carcinoma, gall stones were found twice.

*Age.*—The disease appears to be most commonly met with in patients between the age of forty-five and sixty-five, from fifty to sixty being the most frequent. Several cases have been recorded which have occurred in persons between the ages of twenty and thirty.

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[1] Courvoisier, *op. cit.*

[2] Siegert, *Virchow's Archiv*, Bd. cxxxii. s. 353.

*Diagnosis.*—The presence of a hard, solid tumour in the right hypochondriac region, and in the position of the normal gall bladder, which is continuous with the lower edge of the right lobe of the liver, is tender, painful, and associated with jaundice and cachexia, indicates the existence of malignant disease of the gall bladder. Musser[1] has given an account of a series of a hundred cases of cancer of the gall bladder which were examined after death, and in these he found that a tumour was present in sixty-eight instances. In twenty-seven cases it occupied the right hypochondriac region, in twelve the umbilical region, in four the iliac fossa, in two the inguinal region, and in one the situation of the pylorus ; whilst in ten cases it was adherent to the liver. The surface of the swelling may be irregular, and present a number of localised elevations, in which case it may be confused with carcinoma of the liver. In all cases of supposed malignant disease of the gall bladder, the abdominal and pelvic viscera must be carefully investigated before making a definite diagnosis, so as to exclude as far as possible the occurrence of secondary growths. I have seen a case with all the clinical signs and symptoms of a carcinoma of the gall bladder, which eventually proved to be a case of malignant disease of the upper part of the rectum. The primary growth was very small and localised, but it had given rise to the development of a secondary growth in that portion of the liver which is adjacent to the gall bladder, and this secondary growth protruded into the cavity of that viscus, and infiltrated its walls with carcinomatous elements. The occurrence of carcinomatous affections of the stomach and the head of the pancreas must also be excluded before a definite conclusion is arrived at. The possible occurrence of hydatid cysts and abscesses of various kinds must be taken into consideration when an examination is being made.

*Complications.*—The carcinomatous tumour may extend directly into the adjacent portion of the liver, and there grow and proliferate, so as to form a large malignant mass of tissue ; or secondary growths may develop in more distant parts of the organ. Secondary growths, which are dependent upon a primary carcinoma of the gall bladder, may be met with in the liver ;

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[1] Musser, *Boston Med. and S. Journ.*, Dec. 5, 1889.

but they do not commonly occur in distant viscera, especially in the earlier stages of the affection. The growth may also extend to the neighbouring part of the abdominal wall, and involve its entire thickness, so that it ultimately causes the formation of an external biliary fistula ; or it may extend along the suspensory ligament of the liver and the ligamentum teres, and infiltrate the tissues in the region of the umbilicus. In other cases it becomes adherent to some portion of the alimentary canal, especially the duodenum or the hepatic flexure of the colon or the stomach, and ulcerates through the walls of the viscus to which it has become adherent, so as to establish a fistulous communication between the cavity of the gall bladder and the lumen of the alimentary canal. When the cancerous process invades the tissues of the abdominal wall, it is not uncommon for an inflammatory condition to be induced, which causes the formation of an abscess in connection with the gall bladder.

*Treatment.*—Since the diagnosis of the disease in the early stages of its development is very difficult and often impossible, it is not uncommon to find that when the nature of the affection has been recognised it is too late to adopt any method of operative treatment which offers a fair chance of being followed by a cure. If, however, the disease has been recognised before it has spread extensively to the adjacent tissues, and before it has given rise to the formation of secondary growths, an attempt should be made to effect its total removal. The entire gall bladder must be removed, together with the adjacent portion of the liver tissue if it is involved in the pathological process, and that portion of the cystic duct which is attached to the gall bladder. The method of carrying out this operation is described in the chapters on Cholecystectomy and Resection of the Liver, or Hepatectomy. Hochenegg[1] has removed a carcinomatous gall bladder, together with the adjacent portion of the liver, and six months afterwards the patient had not suffered from a recurrence of the disease. Similar cases have been recorded by Czerny,[2] Winiwarter,[3] Riedel,[4] Bardenhauer,[5] d'Autona,[6] and Lawson Tait[7] ;

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[1] Hochenegg, *Wien. klin. Wchnschr.*, 1889, No. 12.

[2] Czerny, *Deutsche med. Wchnschr.*, Leipzig, 1893, No. 23.

[3] Winiwarter, "Zur Chirurgie d. Gallenwege," *Jubiläums Festschrift gewidmet Th. Billroth*, 1892.

[4] Riedel, *op. cit.*

[5] Bardenhauer, *Mitth. a. d. Köln. Burgerhosp.*, 1887.

[6] d'Autona, *Riforma med.*, Roma, 1888.

[7] Lawson Tait, *Edin. Med. Journ.*, 1889, Oct. and Nov.

but in none of these cases was a permanent cure effected, death generally occurring within a few months of the operation, on account of a recurrence of the disease. In many of these cases, however, the disease had become somewhat advanced before an operation was done. Carcinomata of the gall bladder appear in most cases to grow rather slowly, and not to give rise to the development of secondary metastatic growths in the early stages of the disease ; hence, if a diagnosis can be made early when the neoplasm is strictly localised, local extirpation may offer a fair chance of recovery. In every case where it is thought that a carcinoma of the gall bladder exists,—and this opinion is based upon a fair amount of clinical evidence,—it is recommended that an exploratory laparotomy should be performed at an early period ; so that, if the diagnosis prove to be correct, a radical operation can be carried out, which, it may be reasonably hoped, will result either in a cure of the patient, or at least a considerable retardation of the progress of the disease. In those cases in which secondary growths have developed, or in which the primary affection has extended widely into the surrounding tissues, no surgical operation is advisable, as it will probably not prolong the life of the patient, and, owing to the severity of the procedure, it may be followed immediately by a fatal termination.

*Prognosis.*—The duration of the disease in those cases which have not been submitted to operation has varied within considerable limits, in the practice of different observers. Thus Stiller says, from a study of five cases, that the affection usually lasts from five to six years ; whilst Courvoisier[1] and Musser[2] say that it only lasts for a few months from the time it has been diagnosed. From an investigation of ten cases which have come under my own observation at different times, it appears that in these patients the disease had a duration from a few months to nearly two years, from the time when definite symptoms became apparent. Hence, according to these statistics, Stiller puts the duration too long, and Courvoisier and Musser too short. If the affection can be recognised in the early stages of its development, and appropriate surgical measures be at once adopted, it seems possible that in the future much better results will be obtained than has been the case in the past.

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[1] Courvoisier, *op. cit.*

[2] Musser, *op. cit.*

# CHAPTER XX.

## TUMOURS OF THE BILE DUCTS.

THE bile ducts may become the seat of tumours which have their commencement in the tissues forming the histological elements of the duct walls. In the majority of instances these tumours are malignant in character, and usually commence as an atypical proliferation, either of the epithelium which forms the lining membrane of the ducts, or of the secreting cells in the acini of the mucous glands. A few cases have been met with in which the growth appeared to be of a non-malignant nature.

NON-MALIGNANT GROWTHS.—Wilks and Moxon[1] have described a case of papilloma of the common bile duct which occurred in a child æt. 4. The duct in this case was dilated so as to have the form and shape of a large and somewhat spherical cyst, which had a diameter of several inches, and to the internal surface a large number of pedunculated structures were attached, each one of these bodies consisting of myxomatous tissue and a small amount of muscular fibres. Bennett and Rolleston[2] have reported the case of a woman who suffered from a non-malignant papilloma of the common bile duct, which was met with during the performance of a cholecystotomy for the removal of a gall stone which had been impacted in the common bile duct for about two months. This growth was in close contact with the calculus, and both were removed at the operation. At this time the growth was supposed to be a papilloma, due to the irritation of the gall stone. When this patient was seen a few months afterwards, symptoms of the recurrence of the tumour were present, but it was not possible to ascertain their exact nature, as the patient passed from under observation. These facts render it probable that in this case the tumour was either malignant in character from the first, or that it commenced as a simple papilloma, which at a later period took on malignant characteristics. Simple fibromata do not appear to have been met with as local tumours involving the lumen of the bile ducts. In the post-mortem records of St. Bartholomew's Hospital I have found a description of a localised tumour of the common bile duct which was situated in the submucous tissue, and obstructed the lumen of the duct owing to its projection inwards; this growth was said to be a gumma. The symptoms which are dependent upon the presence of a non-malignant tumour of the bile duct are not sufficiently characteristic to enable the surgeon to diagnose its existence before an ocular examination of the affected portion of the duct can be made through an abdominal incision.

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[1] Wilks and Moxon, "Pathological Anatomy," 1875, p. 465.

[2] Bennett and Rolleston, *Trans. Path. Soc. London*, 1894, p. 83.

MALIGNANT GROWTHS.—As we have already mentioned, these growths are very much more commonly met with than the non-malignant varieties. They are, however, somewhat rare in their occurrence. A primary carcinoma of the bile ducts may commence in any part of the ducts between the biliary papilla, where the common duct opens into the second portion of the duodenum, and the commencement of the ducts within the hepatic substance. When the growth has its origin within the liver, the affection resembles a primary carcinoma of that organ, but on examination the tumour is found to have the structure of a columnar-celled carcinoma. The common bile duct is most frequently the seat of the affection, especially in that section which lies in close connection with the duodenum and in the ampulla of Vater, and also at the junction of the cystic and common hepatic ducts. Occasionally that portion of the common bile duct which lies within the gastro-hepatic omentum is the seat of the commencement of the affection. Very rarely only one of the hepatic ducts or the cystic duct has been first involved. According to the statistics of Musser,[1] which refer to a collection of eighteen cases, the common bile duct was affected in fourteen cases, the hepatic ducts in three cases, and the cystic and hepatic ducts in one case; whilst in the eleven cases which have been collected by Dr. Rolleston the common bile duct was the seat of the primary affection in all. In one case which occurred in St. Bartholomew's Hospital, the carcinoma appeared to have taken its origin in the epithelium of the cystic duct.

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[1] *Musser*, "Primary Cancer of the Gall Bladder and the Bile Ducts," *Boston Med. and S. Journ.*, Dec. 5, 1889.

In some of the cases which have been recorded the tumour has appeared to have commenced either underneath the mucous membrane or in its deeper layers, and in the earlier stages of development to have had the form of a small flattened mass, round or oval in outline, situated in the wall of the duct, and covered on its surface with mucous membrane. Usually, however, the tumour grows directly from the surface of the mucous membrane lining the interior of the diseased bile duct, and tends to cause partial or complete obliteration of the lumen of the duct owing to the blocking up of the canal with the new growth. The carcinomatous infiltration tends to implicate the entire circumference of the duct, and hence to cause the formation of an annular constriction, and to spread along the long axis of the duct, either in the submucous layer or in this layer as well as the muscular coats which have also become affected. In the earlier stages of the disease the carcinomatous infiltration tends to be limited to the tissues which form the walls of the bile ducts, and it is only later that the surrounding tissues become invaded by a direct extension of the pathological process. The primary growth does not usually attain a very large size, in many cases not being greater than a hazel-nut or a walnut. When the growth commences in the cystic duct it may extend into and infiltrate the adjacent portion of the liver; and when that portion of the common bile duct which lies close to the duodenum is the first to be affected, the disease may spread to this portion of the intestine and to the head of the pancreas. In those rare cases in which the tumour is localised to that portion of the common bile duct which lies within the gastro-hepatic omentum, the portal vein may become invaded, owing either to infiltration of the carcinomatous elements or to direct pressure of the malignant mass from without, and as a result ascites may be induced. In those cases of carcinoma of the gall ducts which have been examined microscopically, the growth has been found to have either the structure of a columnar-celled epithelioma or that of a spheroidal-celled carcinoma. The former variety is by far the most common, and, according to Musser,[1] all his eighteen cases were of this nature. Dr. Rolleston's[2] list of eleven cases contains nine in which it is expressly stated that the tumour had the structure of a cylindrical-celled growth. Carcinomatous growths of the head of the pancreas, of that portion of the duodenum which is in the neighbourhood of the biliary papilla, and also of the ampulla of Vater, and the duct of Wirsung, may, when present, give rise to a clinical condition which in almost every respect resembles that which is due to the presence of primary malignant disease of the common bile duct. When the affection commences in the head of the pancreas it has the structure of a spheroidal-celled carcinoma, and hence can usually be distinguished when a histological examination has been made. The symptoms are very similar, but the disease of the pancreas does not always cause complete obstruction to the flow of the bile into the duodenum, although in most cases it gives rise to an obliteration of the common bile duct, either by direct

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[1] Musser, *op. cit.*

[2] Rolleston, "Primary Carcinoma of the Larger Bile Ducts," *Med. Chron.*, Manchester, Jan. 1896.

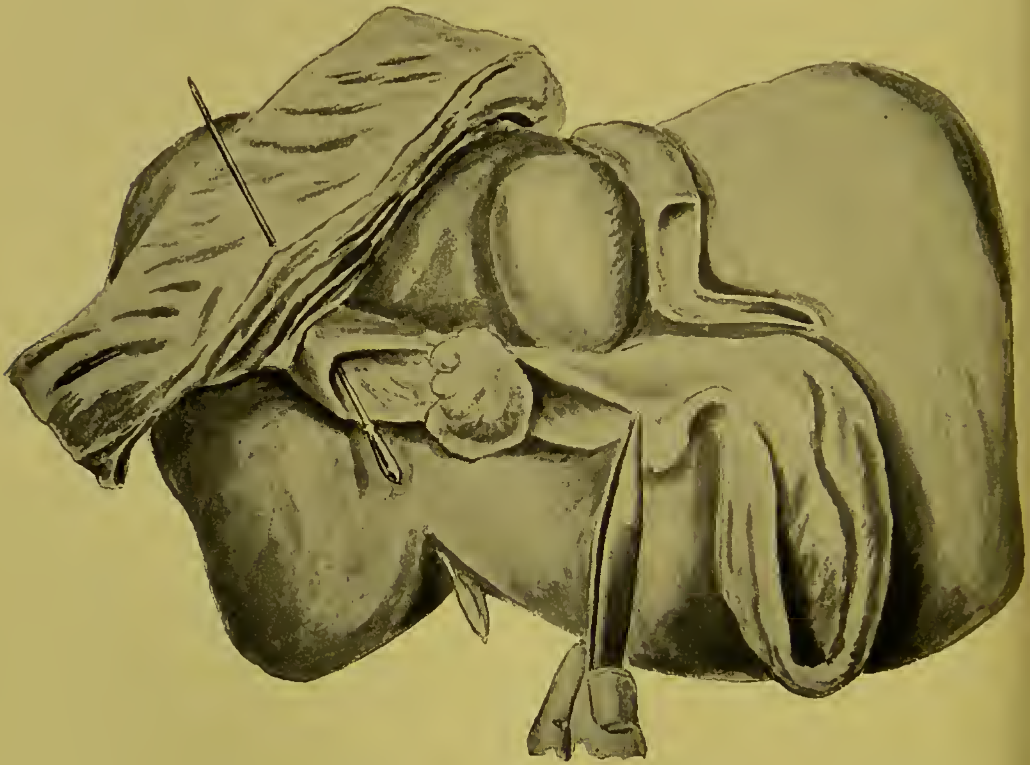

FIG. 40.—Carcinoma of the common bile duct. The inferior surface of the liver showing a new growth springing from the mucous membrane of the common bile duct. Immediately below the junction of the cystic with the common hepatic duct, the common bile duct is blocked by an annular-shaped mass of soft, whitish new growth. Microscopically, the neoplasm was found to be an encephaloid carcinoma.—*St. Barth. Hosp. Museum.*

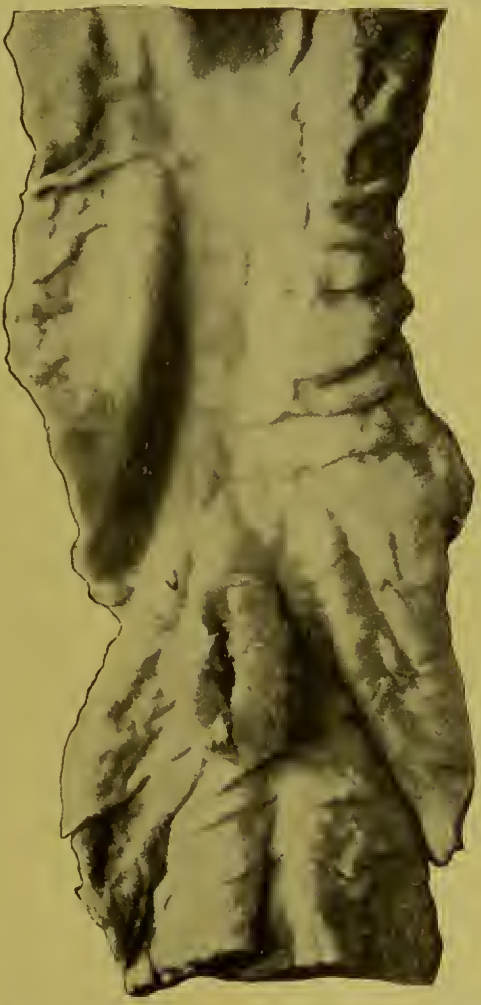

FIG. 41.—Carcinoma of the aperture of the common bile duct. Portion of a duodenum cut open, so as to show a small, soft medullary tumour, papillomatous in appearance, surrounding and closing the orifice of the common bile duct. The tumour has grown from the mucous membrane, and has the structure of a columnar-celled carcinoma. — *St. Barth. Hosp. Museum.*

infiltration or by pressure from without. Fig. 41 is an illustration of a malignant growth of that portion of the duodenum which surrounds the biliary papilla ; it appears to grow from the mucous membrane of the intestine. The patient was a woman, æt. 27, who was intensely jaundiced for three months before her death, and for the nine days which preceded her death she suffered from copious hæmorrhages from the gums, nose, and intestines. When the carcinoma commences in the neighbourhood of the ampulla of Vater and the duct of Wirsung, it is practically impossible to distinguish it from a similar growth from the lowest portion of the common bile duct, which has extended downwards and affected these portions of the biliary canal. This form of growth may extend to the head of the pancreas, in which case on microscopical examination it will be found to have the structure of a cylindrical-celled epithelioma. When secondary deposits develop, they are met with most commonly in the liver or in the lymphatic glands which normally exist in the gastro-hepatic omentum and in the portal fissure of the liver. In rarer instances they may appear in the adjacent peritoneum, the gall bladder, and the suspensory ligament of the liver, and at the umbilicus. Gall stones do not occur so commonly in cases of carcinoma of the bile ducts as in similar affections of the gall bladder. In the eighteen cases which have been referred to by Musser,[1] calculi were present seven times; and in the eleven cases which have been collected by Dr. Rolleston,[2] they were met with on four occasions. It is probable that the formation of the cancerous growth is not directly dependent upon the existence of gall stones, although they may in some cases act as a predisposing cause.

*Sex.*—Carcinomatous affections of the bile ducts do not appear to occur more commonly in one sex than the other. According to Musser's list of eighteen cases, the disease affected the sexes in equal proportions, whilst in Dr. Rolleston's table of eleven cases six were males and five females. The disease affects, for the most part, middle-aged and old people, the commonest decade being 50–60, but occasionally cases have occurred in persons between 20 and 30.

*Symptoms.*—The symptoms of malignant disease of the bile ducts in the early stages are usually very obscure, and not sufficiently definite to justify a diagnosis of the existence of the affection. In those cases in which the common hepatic duct or the common bile duct is the seat of the primary affection, the first symptoms which become manifest are those which are dependent upon an obstruction to the free flow of bile along the main channels into the intestine. These symptoms may be preceded by the occurrence of indefinite pains in the epigastric or right hypochondriac region, and even on both sides of the middle line. According to Head,[3] the "visceral area" which corresponds to the gall bladder and the common bile duct is that of the eighth dorsal segment. When an obstruction to the passage of bile along the common bile duct has been established, jaundice becomes a prominent symptom, and gradually increases in intensity as the disease progresses, until the skin of the patient assumes a dark green or even almost a black colour. Occasionally when the growth presses upon the duodenum or the stomach, attacks of nausea and vomiting appear, and may be very troublesome phenomena. As the obstruction in the bile duct becomes complete, in addition to the increasing intensity of the jaundice, there is a disappearance of bile from the alimentary canal, so that the stools become clay-coloured. At the same time bile pigments can be recognised in the urine, and a constant itching of the skin often becomes manifest, and is a source of much annoyance to the patient. Constipation and symptoms of gastro-intestinal disturbance are not uncommon in this stage, whilst hæmorrhages, which may be subcutaneous, submucous, or in the tissues, may occur. Attacks of pain also occur, but as a rule do not have the paroxysmal character of the hepatic colic which is due to the presence of gall stones, although in some cases where a calculus is also present in the duct such a condition may happen. Ascites develops when the portal vein is pressed upon by the tumour or directly involved in the growth. When the obstruction is complete the bile collects in the bile ducts which are proximal to the tumour, and in the gall bladder and liver, so as to cause a distension of the gall bladder with bile, and the production of a smooth swelling in the right hypochondriac region, and also an enlargement of the liver, which extends downwards below the costal margin for a variable distance, where it is demonstrable to palpation. If the cystic duct is the seat of the primary growth, a condition which is of very rare occurrence, jaundice is not usually present in the early stages, and only appears when the tumour has extended to the common bile duct or the hepatic ducts, or these structures have been pressed upon from without. As the disease progresses the patient loses weight, owing to a general wasting of the tissues, and muscular weakness appears, together with the signs of general cachexia. The primary growth cannot, in most cases, be distinguished as a definite abdominal tumour, on account of its small size and the depth from the surface at which it is placed. In the later stages, when secondary deposits occur in the liver or in the lymphatic glands in the portal fissure, it may be possible to distinguish these tumours as swellings in connection with the liver, but in most of the cases which have been recorded the occurrence of tumours of this kind does not appear to have been noticed. I have seen one case in which the growth appeared to have commenced in the cystic duct, and to have spread thence to the liver, and so caused the formation of a tumour which could be felt during life as a distinct prominence attached to the liver, immediately below the costal margin to the right of the middle line. The pulse is said to be slowed in these affections, owing to the absorption of large quantities of the bile salts. When the obstruction has existed for some time, poisoning with the substances of the bile, or what has been called biliary toxæmia or cholæmia, becomes apparent, and all the general symptoms become more marked. In the final stages, coma, delirium, and general exhaustion usually usher in the fatal termination. Death appears to be due much more to the poisoning which results from the continued retention of the biliary substances, than from the absorption of deleterious materials from the primary or secondary growths. In one case which has been recorded by Coats and Finlayson,[1] extreme distension of the gall bladder with bile occurred, and this was followed by ulceration and rupture of the viscus, with escape of the contents into the peritoneal cavity and the development of peritonitis, which terminated in death.

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[1] Musser, *op. cit.*

[2] Rolleston, *op. cit.*

[3] Head, *Brain*, London, 1893, p. 75.

*Diagnosis.*—Carcinoma of the head of the pancreas, and chronic jaundice due to an impacted gall stone in the common bile duct, are the most usual pathological and clinical conditions which are liable to be confused with carcinoma of the common bile duct or the hepatic ducts, whilst carcinoma of the cystic duct may, in its symptoms, resemble carcinoma of the gall bladder. Jaundice which is due to a catarrhal condition of the bile ducts, and the later stages of carcinoma of the gall bladder, when the primary growth has extended to the common bile duct, may also require to be taken into consideration in making a diagnosis. In those cases of chronic jaundice which are due to the impaction of a gall stone, there can usually be obtained a history of the occurrence of biliary colic, occurring either immediately before the commencement of the attack of jaundice, or at some previous period when a similar, though less severe, attack of jaundice resulted. The occurrence of biliary colic is not, however, a definite indication that the disease is due to the presence of a gall stone alone, since in a certain number of cases of carcinoma of the bile ducts biliary calculi are found to be present, whilst a patient may be the subject of an impacted gall stone without any signs of colic becoming manifest, and slight attacks of colicky pains may occur in a case of carcinoma of the bile ducts. When a well-marked attack of biliary colic immediately precedes the development of jaundice, it may be concluded that in all probability the jaundice is due to the impaction of a gall stone in the common bile duct or in the common hepatic duct; and if there is a distinct history that the patient at former periods has been the subject of gall stones, a similar conclusion will be justifiable in most cases. When, however, the attack of jaundice is not preceded by these conditions, the condition of the alimentary canal should be carefully investigated, in order to eliminate as far as possible the occurrence of catarrhal jaundice. The appearance of an attack of catarrhal jaundice is usually preceded by symptoms of gastro-intestinal disturbance, such as diarrhœa and vomiting, and the attack in most cases passes off in a few weeks, or occasionally in even a shorter time, so that it ought not to be difficult to differentiate between an attack of jaundice of this kind and one which is due to malignant disease of the bile ducts. The duration of the attack of jaundice is of much importance in the diagnosis between obstruction which is due to malignant disease, and that which is due to an impacted gall stone. In the former case the affection rarely lasts more than a few months before terminating fatally, whilst in the latter it may last for a much longer time, even years, before a fatal result follows. When this does occur, it is generally due either to an intercurrent affection or to some complication, and not to chronic poisoning with bile. The obstruction in these cases does not remain complete, and, after the impaction of the calculus has existed for some time, the duct becomes dilated, so as to allow the passage of a small quantity of bile into the intestine, and in some cases the jaundice may either vanish partially or almost completely. In those cases which are due to a primary carcinoma of the head of the pancreas, it is occasionally possible to distinguish a tumour situated upon the posterior wall of the abdomen and in the epigastric region, but in people with thick abdominal walls this is exceedingly difficult. When jaundice occurs in this class of disease, it has the characteristics of that which is due to obstruction of the common bile duct with a carcinomatous tumour, but occasionally it is found to be absent. The pain which is associated with a pancreatic tumour tends to be located in the epigastric region, but this is not constant, owing to the fact that the affection so commonly spreads to the common bile ducts, and gives rise to the appearance of pain in the right hypochondrium. Carcinoma of the gall bladder appears to be more commonly the cause of the development of secondary growths in the liver than when the bile ducts are the seat of the primary disease. The tumour of the head of the pancreas may press upon or invade the duct of Wirsung, and cause an obstruction to the passage of the pancreatic secretion into the duodenum, in which case an excess of fat is said to be found in the fæces. Other diseases may be the cause of the appearance of chronic jaundice, such as cancer of the pyloric portion of the stomach, secondary malignant growths in the lymphatic glands, in the gastro-hepatic omentum, or the portal fissure of the liver, or in the liver itself; inflammatory conditions of the liver which are followed by the production of scars, such as tertiary syphilis, and cystic and other tumours of the liver or the neighbouring structures, which, by their size, cause compression of the common bile duct and obstruction to the free passage of the bile. Cases of aneurism of the hepatic artery and the upper portion of the abdominal aorta have been known to act in this manner. It can be said that chronic persistent jaundice occurring in middle-aged or old people, which gradually increases in intensity, is in almost half the cases due to some form of malignant disease.

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[1] Coats and Finlayson, *Glasgow Med. Journ.*, 1890, vol. ii. p. 84.

*Treatment.*—On account of the great difficulty which is experienced in making a correct diagnosis in the early stages of carcinoma of the larger bile ducts, it is not possible in the majority of cases for surgery to offer any strong hope that a cure will be effected as the result of the performance of operative measures. When a patient has suffered from chronic jaundice for a considerable period, the tissues do not appear to be very tolerable of surgical interference. In one case of this kind which I recently operated upon, hæmorrhage followed which was very difficult to arrest; but in a second case in which an exploratory laparotomy was performed, the abdominal wound healed in a few days without any unpleasant symptoms occurring. When it appears probable that a localised carcinomatous affection of the common bile duct exists, and there are no manifestations of the presence of secondary growths, and the patient is in other respects a fair subject for the performance of an operation, an exploratory laparotomy should be carried out, so that the course of the bile ducts may be examined digitally and visually. In most cases of this kind it is found advisable to make the abdominal incision in the linea alba and above the umbilicus. If the cystic duct is found to be the seat of the growth, that portion of the duct which is implicated together with the gall bladder should be removed; and if the liver is found to be affected owing to a slight extension of the carcinomatous process, the involved part should be resected, if this can be done with safety, and there are no signs of secondary deposits in other parts of the organ. In those cases in which the common bile duct is found to be the seat of the disease, the affected portion should be excised and the ends closed with sutures. The fundus of the gall bladder is afterwards made to communicate with the duodenum or other portion of the intestine by the performance of a cholecystenterostomy. Usually, however, it is not possible to remove the diseased portion of the common bile duct, owing to the fact that the adjacent structures are infiltrated with the growth and cannot be removed. The method of treatment which is advisable in these cases consists in the establishment of a communication between the gall bladder and the alimentary canal. By this means the continuation of the condition of cholæmia will be avoided at least for a time, and life will in all probability be prolonged. If the carcinomatous process is found to have commenced in the common hepatic duct, or in the cystic duct at its junction with the common bile duct, it is not possible to perform an operation which will be of any avail. When the growth involves the head of the pancreas, and invades the common bile duct, it is not advisable to attempt the local removal of the growth, on account of the deep and important anatomical connections, and the impossibility of removing the entire disease. In these cases, also, it is only possible to perform the palliative operation of cholecystenterostomy. This operation has been followed in such patients by very fatal results in the past, and therefore some surgeons think that its performance is unjustifiable. In one case of this kind, where I performed a cholecystenterostomy for the temporary relief of a patient who was suffering from chronic cholæmia, the result of an obstruction of the common bile duct by a cancerous growth in the head of the pancreas, the patient died ten days afterwards, owing to constant hæmorrhage from the line of adhesion after a Murphy's button had separated. As this method of treatment, however, is the only one which offers any chance to the patient of the prolongation of life, I think that it is to be recommended, especially in those cases in which the jaundice has not lasted for a very long time. If, after the abdomen has been opened and examined, the obstruction is found to be due to the impaction of a biliary calculus, it should be removed in the manner which has been described in the chapter on Cholelithiasis.

*Prognosis.*—In most of the cases of malignant disease of the bile ducts which come under observation, the prognosis is very unfavourable. The patients usually die within a few months from the time when the disease has become thoroughly established. Life may be prolonged for some time in those cases in which it is found possible to perform a palliative cholecystenterostomy. In one case of this kind which has been recorded by Reclus, the patient lived for twenty-one months after the fistulous communication had been established, and similar cases have been met with by Murphy of Chicago. It is possible that in the future, if more attention is paid to the diagnosis of the disease in its early stages of development, and appropriate surgical measures are at once adopted for its cure, the prognosis will not be so unfavourable as it is considered at the present time.

# CHAPTER XXI.

## SUBPHRENIC OR SUBDIAPHRAGMATIC ABSCESS.

Subphrenic or subdiaphragmatic abscess is an affection which is characterised by the development of a localised collection of pus, or pus and gas, between the lower surface of the diaphragm and the adjacent surface of the liver. As we have seen in the section which is devoted to anatomy that the liver is not completely covered with peritoneum, and that the greater portion of the uncovered area lies in close relation with the inferior aspect of the diaphragm, it necessarily follows that an abscess within the limits mentioned may be formed in connection with the peritoneal cavity, as a localised purulent peritonitis; or it may arise in the extraperitoneal tissues, and be limited as regards its hepatic boundary to that portion of the surface of the liver which is destitute of a peritoneal covering. Thus there are two varieties of subdiaphragmatic abscess, one being called intraperitoneal and the other extraperitoneal. In the former variety the internal surface of the abscess wall is covered at first with a layer of endothelium which represents the endothelium of the serous membrane, and in the latter the inner surface of the abscess is connective tissue which represents subperitoneal tissue, the fascia covering the lower aspect of the diaphragm or the fibrous tissue capsule of the liver. The intraperitoneal variety is more frequently met with than the extraperitoneal. In most cases the right lobe of the liver is the inferior boundary of the abscess, but in a certain number of cases the affection is confined to the superior aspect of the left lobe, whilst occasionally both lobes are involved. When both lobes form part of the boundaries of an abscess the affection is usually extraperitoneal, although in rare instances it may be intraperitoneal, and the inflammatory process then spreads through the suspensory ligament, which divides the upper aspect of the liver into right and left lobes.

*Etiology.*—An abscess between the diaphragm and the liver may result from a variety of pathological causes. In the majority of cases it is due to the extension of an inflammatory process from a focus of disease in one of the adjacent viscera, but occasionally distant viscera may be the seat of the primary affection. The pathological causes of the disease may be arranged in the following groups, viz.:—

(1) *Cases due to traumatic causes.*—Injuries which result in the establishment of a subdiaphragmatic abscess are either penetrating or non-penetrating. When the hepatic region is the seat of an injury, it may happen that a contusion or small rupture of the liver is produced, and this is followed by hæmorrhage, and at a later period suppuration occurs. This is probably due to the activity of micro-organisms which have been carried to the seat of injury by the blood stream, or have passed there directly from the neighbouring portion of the alimentary canal. The impaired vitality of the injured tissues and the presence of a blood clot favour the growth and multiplication of the micro-organisms of suppuration when they have once effected an entrance. In several recorded cases a small rupture of the upper portion of the spleen has been the cause of a subdiaphragmatic abscess, owing to the development of a localised collection of blood in the region of the liver, and subsequent suppuration. Blows and kicks in the hepatic region, falls from a height, crushes of the abdomen, as in buffer accidents, and contusions from spent cannon balls, have all been the cause of the formation of an abscess in the subphrenic region. Perforating wounds of the thoracic or abdominal wall, which lead inwards to the subdiaphragmatic space, may be succeeded by the establishment of a subdiaphragmatic abscess, and when this occurs it is usual for the wound to be infected by the micro-organisms of suppuration, either at the time of reception of the injury or very shortly afterwards. Most of the recorded cases of this nature have been caused by gun-shot wounds or by stabs with a sharp instrument, and the liver or one of the thoracic viscera has also been injured.

(2) *Cases due to pathological conditions of some portion of the alimentary canal.*—(*a*) *The stomach.*—The stomach has been found, in a considerable number of cases, to have been the starting-point in the development of a subdiaphragmatic abscess. Chronic gastric ulcers, which are non-malignant in character, have been found to be more commonly the cause than those

which are malignant. The ulcer extends through the walls of the organ, often causing adhesions between the walls and the adjacent structures, especially the posterior aspect of the anterior abdominal wall; and a perforation is established which is followed by inflammation and suppuration, and the formation of a localised collection of purulent material between the lower surface of the diaphragm and the superior aspect of the liver, stomach, or adjacent structures. The perforation may become closed after the inflammation has extended to the under surface of the diaphragm, the hole being represented only by a small scar, in which case the resulting abscess will contain only fluid matter. If the perforation remains open, the resulting abscess will contain a quantity of air or gas in addition to purulent matter. In some cases an abscess contains gas which does not come from the lumen of the stomach, but is produced by the agency of gas-producing micro-organisms. Cases have been recorded in which it seems probable that an ulcer of the stomach has been the cause of the development of a subdiaphragmatic abscess, owing to the absorption of septic material from the ulcerative surface and its conveyance by lymphatic channels, but in the majority of these cases a perforation has taken place and infective material has passed from the cavity of the stomach into the surrounding tissues. The formation of adhesions and subsequent perforation may occur on either the anterior or posterior aspects of the stomach. When the ulcer of the stomach is situated on the posterior aspect, adhesions take place between the stomach and the peritoneum forming the posterior boundary of the lesser sac, and the development of the abscess commences on the posterior abdominal wall in the region of the postero-inferior border of the liver.

(*b*) *The duodenum.*—Ulcers of the duodenum or the pylorus may perforate the wall of the intestine and become the cause of the formation of a subdiaphragmatic abscess in a manner which is similar to that of ulcers of the stomach. When the duodenum is the seat of the perforation it is usual for the resulting abscess to be developed upon the right side, but when the abscess is extraperitoneal it extends to both sides of the middle line; this condition was observed recently in a case which I saw in St. Bartholomew's Hospital. Ulcers of the duodenum which are followed by subdiaphragmatic abscess, are usually situated in the upper portion and not in that part which lies below the pancreas. A case has been recorded by Maydl in which a foreign body perforated the wall of the duodenum and caused a subdiaphragmatic abscess. In the remaining recorded cases a non-malignant perforating ulcer has been the cause. When rupture of the duodenum occurs owing to some form of mechanical injury, the lower portion of this section of the intestine is injured, and if extravasation of the contents takes place, an abscess is formed which tends to spread downwards and not into the subphrenic region.

(*c*) *The small intestine* (beyond the duodenum).—This portion of the alimentary canal rarely becomes the cause of the development of a subdiaphragmatic abscess, but a case has been recorded by Blocq where an ulcer of the lower part of the ileum in typhoid fever was the direct cause of an abscess of this kind.

(*d*) *The large intestine.*—The cæcum and the vermiform appendix are frequently the seat of ulceration and perforation, which are followed by appendicitis or perityphlitis, and these conditions have, in many cases, been the cause of the formation of subdiaphragmatic abscesses. It has been shown by the experiments of Sänger, that material which has been injected into the tissues which lie behind the cæcum tends to extend upwards behind the ascending colon and in front of the right kidney until it reaches the subphrenic space of the right side. Collections of fluid in the retrocæcal region were shown also to have little tendency to pass downwards into the inguinal canal or into the transverse mesocolon and the mesentery. These experiments of Sänger showed that the region of the cæcum, the ascending colon, and the duodenum, were the parts of the intestinal canal which would in all probability, when the seat of perforative affections, be the starting-points in the development of a subphrenic abscess, and such, in fact, has been found to be the case clinically. Ulceration and perforation of the descending colon or of the transverse colon are much less frequently the cause of a subphrenic abscess.

(3) *Cases which are due to pathological conditions of the kidney and perinephric tissues.*—The kidney is normally situated in the lumbar region, and has the colon lying directly in front of it. When the viscus itself is the seat of a suppurative affection, the perinephric tissue which surrounds it becomes involved in most cases, and when this occurs it follows that the collection of pus will tend to track upwards into the subphrenic space and thus

become the cause of the establishment of an abscess in this region. A number of cases have been recorded in which the sequence of events has been as above. Cases have also been recorded in which the kidney has been injured by traumatism, hæmorrhage has followed into the perinephric tissue, and later the collection of blood has become infected with the micro-organisms of suppuration, and an abscess has been produced which has extended upwards and involved the subphrenic space. Calculi of the kidney, tuberculosis and suppurative processes in the kidney, which have spread from the lower portions of the urinary passages, have been noted as the causes of a subphrenic abscess.

(4) *Cases which are due to inflammatory affections of the gall bladder or biliary ducts.*—The fundus of the gall bladder lies in close relation to the posterior aspect of the ninth costal cartilage and the diaphragm which is attached to it. When it becomes the seat of gall stones and inflammation, the viscus may become fixed to the diaphragm, and if perforation occur, the extravasated material will tend to pass into the subphrenic space and start the development of an abscess. In a similar manner, when the intra-hepatic bile ducts are involved in a suppurative process, one of them may become dilated and burst upwards upon the superior or anterior aspect of the liver, and give rise to a like state of affairs. A suppurative inflammation of the extra-hepatic bile ducts may also be followed by rupture and the formation of a subphrenic abscess.

(5) *Cases which are due to affections within the thorax.*—Localised collections of pus in the lower portions of a pleural cavity, especially the right, as well as gangrene or chronic tuberculosis of the base of a lung, have been the cause of the development of a subphrenic abscess, owing to perforation of the diaphragm and direct extension of the inflammatory process. When the lungs are the seat of the primary affection, perforation of the diaphragm is preceded by adhesive inflammation of the pleura covering the base of the lung and the upper surface of the diaphragm. Suppurative conditions of the pericardium are so soon fatal that they do not exist long enough before death to cause perforation of the diaphragm and subphrenic abscess.

(6) *Cases which are due to caries of the overlying ribs or costal cartilages.*—Tubercular disease of one of the ribs or costal

cartilages which lie in relation with the diaphragm may be the exciting cause of a subphrenic abscess. Maydl[1] and Lannelongue have recorded such cases, but it is exceedingly rare.

(7) *Cases which are due to suppuration in hydatid cysts.*—Hydatid cysts which are situated in the subphrenic space, or, in rarer cases, in the liver immediately underneath the capsule, may become the seat of suppuration, and become converted into a fluid swelling which has all the symptoms of a subphrenic abscess. Maydl, in his work on subphrenic abscess, has collected seventeen of these cases from surgical literature, and he also gives details of them. In some of the recorded cases the hydatid cyst has been situated between the lower surface of the left side of the diaphragm and the upper aspect of the spleen or the left kidney, and then the resulting abscess has been usually limited to the left side of the body.

(8) *Cases which are due to metastatic causes.*—Metastasis is a frequent cause of the development of a subphrenic abscess. It is observed more frequently in tropical countries, this increased frequency being associated with the more common occurrence of dysentery. In this country, however, this form of abscess is not very uncommon, as during the past few years I have seen two cases which have arisen in this manner. In the majority of cases which arise as a result of metastasis, it is found that the abscess is secondary to an ulcerative affection of some portion of the abdominal or pelvic part of the alimentary canal. I have seen one case in which the affection followed an ulceration of the vermiform appendix, and another in which it followed a secondary pyæmic abscess of the liver. Abscess of the spleen, suppurative processes in the mesentery, and fistula in ano, have been noted as causes of metastatic subphrenic abscess, and also general pyæmic conditions. The pus from some of these cases has been examined, and in it have been found the various micro-organisms of ordinary suppuration, and in the cases which have followed dysentery the amœbæ coli are said to have been seen. Cases have also been recorded in which septic and suppurative affections of the female pelvic generative organs have been the primary causes of the development of subphrenic abscesses.

Nearly all cases of subphrenic abscess will be found to fall under one or other of the above classes, but there are occasional examples of the disease in which the exact pathology of the affection does not appear clear, and the case cannot be grouped in one of the above classes.

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[1] Maydl, "Ueber subphrenische Abscesse," 1894.

Maydl in his work has collected from surgical literature 179 7iB
cases of subphrenic abscess, and of these seventy-three were due to affections of the alimentary canal, twenty-four to traumatic causes, twenty to affections of the biliary system, seventeen to hydatid cysts, eleven each to perinephritic and metastatic causes respectively, nine to thoracic diseases, three to caries of the ribs, and eleven in which the cause was either uncertain or was due to causes other than the above. I have examined the records of St. Bartholomew's Hospital for the past ten years, and have found that ten cases have occurred. Carl Beck[1] has recently recorded four fresh cases of this affection.

*Symptoms.*—The onset and development of a subphrenic abscess may be either gradual or sudden. When gradual, the symptoms are usually indefinite, and the early manifestations of the disease are attributed to indigestion or slight gastric or bilious affections. The adjacent pleura in many cases becomes the seat of a pleurisy, and, on auscultation, friction sounds can be heard in the region of the base of the lung, and at the same time the patient complains of pain localised to the lower part of the thorax, and worse during the movements of respiration. In other cases pain may be felt over the apex of the right shoulder, and this when present is said to be a referred pain due to irritation of the sensory branches of the phrenic nerve, which come from the third and fourth cervical nerves, whilst the sensory nerve to the shoulder comes from the same place. Cough may be noticed as a frequent and somewhat distressing symptom. The temperature is in many cases raised, and tends to be "hectic" in character. When the onset of the affection is sudden, it is most usually due to the perforation of one or other of the abdominal viscera, and is associated with an attack of violent localised abdominal pain. This is due in most cases to the rupture of an ulcer of the stomach or duodenum, or to the rupture of a collection of pus in the cæcal or perinephric region. When the abscess is due to traumatism, a distinct history of this can generally be obtained. The attack of pain which accompanies the rupture may be localised in one or other hypochondriac region, or it may tend to spread over the whole abdominal area, in which case it will suggest the occurrence of perforative peritonitis. In cases of subphrenic abscess, the tenderness of the abdominal area which follows the rupture, soon becomes localised to the subdiaphragmatic region. Vomiting is frequently met with in cases which are due to rupture or perforation. When a subphrenic abscess is secondary to a primary affection elsewhere, it is not uncommon to find, either in the history or in the condition of the patient, that there are signs and symptoms of this primary disease. Thus symptoms of preceding inflammation in the cæcal or renal regions are not uncommon, and often give valuable help in making a correct diagnosis. As regards the general symptoms, the temperature is usually raised and "hectic" in character, and often this increase in the temperature is associated with alternating attacks of diarrhœa and constipation. In many, pain and difficulty in breathing are experienced, whilst in advanced cases considerable loss of flesh, wasting, enfeeblement of the appetite, and a general

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[1] Carl Beck, *Med. Rec.*, N. Y., 1896, Feb. 15.

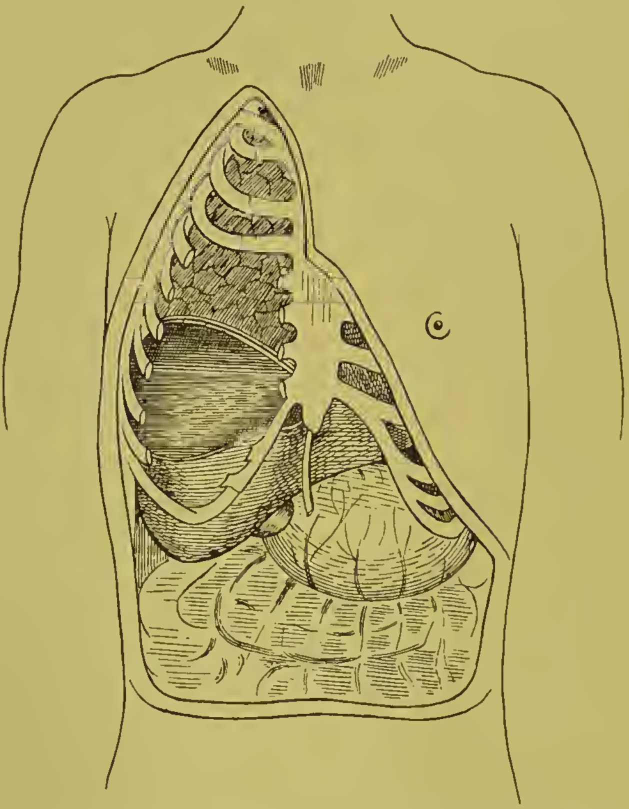

FIG. 42.—Subdiaphragmatic abscess. Semidiagrammatic illustration of a subdiaphragmatic abscess of the right side. The abscess cavity is filled entirely with pus.

loss of strength and mental power, are noticed. These cases often develop the typhoid state. In addition to symptoms, a subphrenic abscess gives rise to a certain number of physical signs, which are of great value in establishing a correct diagnosis. These signs vary according to whether the abscess is situated on the right, the left, or both sides, and whether it contains pus alone, or a mixture of gas and purulent matter. When the abscess contains only pus, the liver is in most cases thrust downwards to a variable extent, so that its inferior margin can be felt below the costal arch. This depression of the liver is not pathognomonic of the disease, since it is not always present in cases of subphrenic abscess, and when it is met with it may be due to other conditions, such as empyema and effusion into the right pleural cavity, or hydatid disease of the liver or the subphrenic region. When the hepatic region is palpated, the overlying tissues in cases of subphrenic abscess are more resistant than usual, the respiratory movements of the part are less than normal, and the liver itself and the adjacent portion of the thoracic and abdominal walls are more fixed than usual. When the abscess is located in the left hypochondrium, an abnormal swelling will be found to occupy this region with

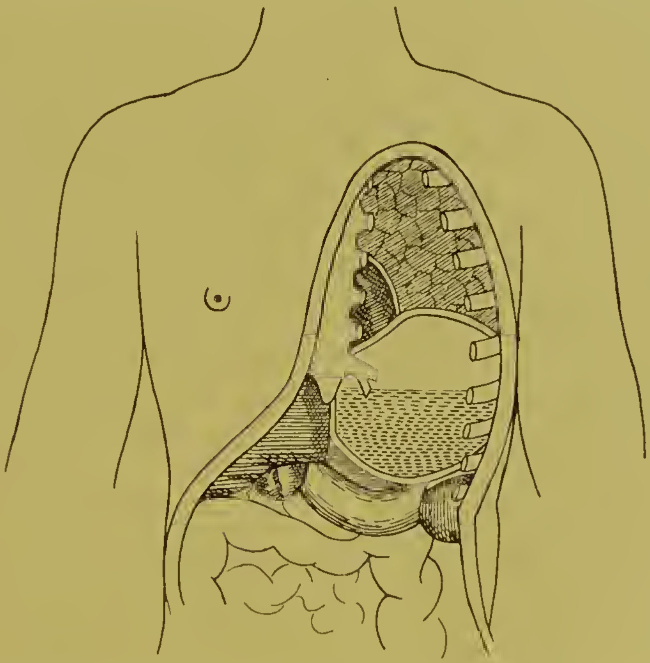

FIG. 43.—Subdiaphragmatic abscess. Semidiagrammatic illustration of a subdiaphragmatic abscess of the left side. The contents are pus and gas.

the physical characters of a collection of pus. On percussion, dulness is found at the base of the thorax, which is similar to that met with in cases of localised pleural effusion. In some cases there is slight displacement of the heart, usually to the left, but this is not constant, and some observers have even denied its existence. There is no doubt, however, that in some instances slight displacement of the apex beat of the heart is to be noted. When the abscess contains gas mixed with purulent matter, the physical signs are somewhat different. The liver may be thrust downwards as in the former case, and usually this depression is more distinct, and the lower margin of the liver can be felt some distance below the costal arch. On percussion the liver dulness is found to be considerably diminished or even to be almost absent, and to be replaced by a note which is "amphoric" in character. This is caused by the presence of gas within the abscess cavity. On auscultation the vesicular breath sound is heard down to the third or fourth rib, but below that a distinct "amphoric" sound is heard. The percussion sound over the abscess cavity may be very tympanitic, or, according to Gee, the "bell sound" may be met with. On shaking the patient a succussion splash will usually be elicited, but in many cases the general condition of the patient will not allow this to be sought for.

*Complications.*—When an abscess is situated in the subphrenic space, it occasionally happens that a communication is established with the overlying pleural cavity owing to perforation of the diaphragm, and if this abscess contain gas as well as purulent matter a pyopneumothorax will be produced. Perforation into the pleura is usually accompanied by severe pain, difficulty in breathing, and a certain amount of shock, whilst the physical signs which are met with in the chest indicate the presence of gas in the pleura and collapse of the lung. Perforation may also take place into the pericardium, in which case there will be signs of pericarditis, and if the abscess contained gas there will be signs of gas in the pericardial space. In other cases the inflammatory process may spread slowly through the diaphragm and cause localised pleurisy and subsequent adhesion of the parietal and visceral layers of the pleura, where they lie in contact upon the upper surface of the diaphragm, and then perforation of the abscess wall may take place, and the purulent matter pass into the lung and be expectorated. In rare cases the abscess may burst into the peritoneal cavity and set up a general septic peritonitis. Occasionally the abscess may extend to the surface of the body, either through the anterior abdominal wall or through one of the intercostal spaces, and its contents be discharged owing to a spontaneous rupture. In still other cases perforation may take place in some part of the alimentary canal, most commonly the stomach or the adjacent portion of the colon, and then the contents are passed per anum or even vomited when the stomach is the seat of the perforation. When a communication is established between the cavity of a subphrenic abscess and the lung or the lumen of the alimentary canal, unpleasant symptoms result. When the lung is the seat of the communication, fœtid expectoration is a marked symptom; and when the stomach is involved, unpleasant eructations of foul gas occur. When an empyema follows as a result of rupture into the pleura, or pleurisy is set up owing to extension of the inflammatory process through the diaphragm, difficulty in breathing and other thoracic symptoms are usually accentuated.

*Diagnosis and differential diagnosis.*—Many cases of subphrenic abscess present considerable difficulties in diagnosis. The affection is liable to be mistaken for an abscess of the upper aspect of the liver, a solid tumour of the liver, a subphrenic hydatid cyst, a pleural effusion, or an empyema, and when it contains gas as well as purulent matter it may be mistaken for a pneumothorax or a pyopneumothorax. The history of the affection often affords great assistance in locating the abscess. In subphrenic abscess there is often a history of abdominal symptoms and absence of cough or expectoration, whilst in pleural effusion the reverse history is usually obtained. The heart also is not displaced to so considerable an extent as in cases of pleural effusion or empyema. On auscultation the vesicular breath sound can be heard for a variable distance below the clavicle, usually as far as the lower border of the third rib, and in deep inspiration it can be distinguished at a lower level, and below this there is an "amphoric sound," whilst in the case of pneumothorax vesicular breath sounds cannot be distinguished on the affected side. In many cases it is necessary to explore the region of the swelling with the needle of an aspirator. When purulent matter and gas are withdrawn, it is certain that an abscess cavity exists in the region of the diaphragm, and, according to Fürbringer and other observers, if the needle moves upwards and downwards with the movements of respiration, it is clear that a subphrenic abscess is present. This sign is, however, not pathognomonic of the affection, since the needle may become fixed in the walls of an abscess, and not in the diaphragm, or, if the diaphragm has been thrust upwards to a considerable extent, the needle may pass into the abscess cavity and have no movements communicated to it. If an encysted purulent pleural effusion of the basal portion of the chest is present, it will usually be quite impossible to distinguish it from a subphrenic abscess. If, however, the swelling has been shown to contain pus by means of the aspirating needle, it does not make any material difference, since the treatment of both affections is similar. If there is any doubt of the nature of a swelling which is situated in the subdiaphragmatic region, it is always advisable to explore it with the needle of an aspirator, adopting in every case strict aseptic precautions.

*Treatment.*—When the diagnosis that a collection of pus exists on the under surface of the diaphragm has been established, it is indicated in every case that surgical measures should at once be adopted for its evacuation and the subsequent drainage of its cavity. The collection of pus may be reached by three different routes, either through the anterior abdominal wall, immediately below the margin of the costal arch, or through the thoracic wall by resection of portions of one or more ribs, or from the lumbar region by means of an incision which follows the lower border of the last rib. The location and connections of the abscess determine which of these methods should be adopted. When the abscess protrudes from beneath the costal margin, an incision should be made over its most prominent part in the anterior abdominal wall, and, whenever it is possible, it is advisable that this method of evacuation should be adopted, since it offers better chances of recovery than either of the other methods. When, however, there is also an empyema, or if the abscess is situated entirely underneath the costal arch, it is necessary that an incision should be made through the thoracic wall, and portions of one or more ribs resected, and the pleural cavity opened. Then the diaphragm is incised and the abscess is evacuated and drained by the transpleural method. When the subphrenic abscess is due to a perinephric affection, it is advisable to make an incision along the lower border of the last rib in the lumbar region, and to drain the purulent collection by this route. When the abscess cavity has been evacuated,—and it should be borne in mind that the evacuation ought to be carried out slowly so as to cause as little shock as possible,—it is irrigated with an antiseptic solution and drained with a large rubber drainage-tube. The details which are to be observed in the performance of these operations are given in the chapters which are devoted to operative procedures.

*Prognosis.*—The prognosis in cases of subphrenic abscess depends to a very great extent upon the cause of the affection. In those cases which are associated with or are dependent upon a malignant ulcer of the stomach or some other part of the alimentary canal, the prognosis is very grave. When the disease is recognised at an early stage, and it is possible to treat the primary affection by radical measures, it is possible that a cure may be effected. If, however, the primary disease is not amenable to direct surgical interference, the treatment of the subphrenic abscess can only be regarded as a palliative measure which may prolong life to a limited extent. When the abscess is due to an inflammatory affection elsewhere, and the presence of the disease is recognised early, and suitable operative treatment is carried out without delay, the prognosis is much better. In some cases in which perforation of the abscess has occurred, either into the alimentary canal or into the lung, a spontaneous cure has followed, but cases of this kind are very rare. Carl Beck[1] refers to six cases of this kind which he has found in the literature of 104 cases. It has not been possible to gauge the nature of the prognosis from the microscopical examination of the purulent matter evacuated from the abscess. In it there have been found many varieties of micro-organisms, especially those of ordinary suppuration, but in a certain proportion of the cases no living organisms have been met with.

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[1] Beck, *op. cit.*

# CHAPTER XXII.

## BILIARY FISTULÆ.

A biliary fistula is an abnormal communication or opening in connection with either the gall bladder or one of the biliary ducts through which bile passes. These fistulæ are of two kinds: those which open upon the external surface of the body, and are called external fistulæ, and those in which there is a communication between the lumen of one of the hollow abdominal viscera and the cavity of either the gall bladder or one of the biliary ducts, and which are known as internal fistulæ.

External Fistulæ.—An external biliary fistula is characterised by the presence of an aperture upon the surface of the body, usually in some part of the abdominal area, which leads into a tract which communicates with the gall bladder or one of the bile ducts, and from this aperture bile exudes. In the majority of cases it is found that the fistula communicates with the cavity of the gall bladder. Gall stones are a frequent cause of the formation of a biliary fistula, owing to the fact that they are prone to give rise to the development of inflammatory processes which affect the gall bladder or biliary ducts, and cause these structures to become adherent to the posterior aspect of the anterior abdominal wall; and when an abscess arises in this position it makes its way through the substance of the overlying abdominal wall, and opens upon the surface and discharges its contents. If this abscess also involves the gall bladder or the bile ducts, a communication will then be established between the lumen of these structures and the surface of the body, and in many cases a biliary fistula will result. The gall stones which have been the cause of the inflammatory process are often discharged with the contents of the abscess, and in some cases it is found that calculi may be discharged at intervals for a long time after the development of the fistula. If all the calculi are discharged from the fistula, or pass along the cystic and common bile ducts into the alimentary canal, the aperture may close up spontaneously; but usually some of them remain either in the cavity of the gall bladder, or in some part of the fistulous tract, and become the cause of a chronic irritation which keeps open the fistula, from which these calculi may be discharged at periodical intervals. I have recently seen a case of this kind, in which a collection of gall stones in the gall bladder gave rise to the formation of an abscess which opened on the surface of the abdomen a short distance above the umbilicus, and from the aperture a gall stone was occasionally discharged. When a gall stone has passed into one of the bile ducts, and subsequently caused inflammation, it usually gives rise to the formation of adhesions between the duct and some part of the alimentary canal, and may pass through the wall of the adherent viscus and so cause the development of an internal fistula. An external biliary fistula, however, occasionally follows an inflammatory process in connection with one of the bile ducts, but this is not common. Penetrating wounds of the abdomen, and occasionally of the lower portion of the right side of the thorax, which involve the liver or the biliary system, may be the direct cause of the establishment of a biliary fistula. Thus it occasionally happens that a gunshot wound, or a stab which penetrates the liver or gall bladder, is followed by the formation of a fistula, owing to the non-closure of the external wound and the escape from it of a quantity of bile. Hepatic abscesses of traumatic origin are said to be very liable to result in the formation of a biliary fistula; and abscesses of the liver due to other causes may also give rise to the same result, owing to the affected portion of the liver having become adherent to the abdominal wall, and the abscess discharged externally. In some cases which have been recorded, a fistula has arisen as the result of the surgical treatment of a hydatid cyst or an abscess of the liver. The operation of cholecystotomy is in some cases followed by the formation of a temporary or permanent biliary fistula. Actinomycosis of the liver may gave rise to the formation of an abscess which bursts externally, and is followed by the appearance of a fistula from which pus and bile exude. I have seen one case of this kind, but the amount of bile which was mixed with the purulent matter was quite small. Cancer of the gall bladder may extend to the adjacent portion of the abdominal wall and terminate in the formation of a fistula. One or two cases have also been recorded in which an infant has been said to suffer from a congenital umbilical biliary fistula, which was supposed to be due to non-obliteration of the lumen of the umbilical vein and the establishment of a communication between this vein and one of the smaller intra-hepatic bile ducts. When external biliary fistulæ are met with, the fistulous aperture is usually found to be situated in the right hypochondriac region or at the umbilicus, but it may be in the inguinal region, the hypogastrium, or between two of the lower ribs, especially on the right side. The greater frequency of the fistula at the umbilicus and in the right hypochondriac region is due, in the first case, to the ease by which an inflammatory collection of purulent matter can pass between the two layers of the falciform ligament, and along the ligamentum teres to the posterior aspect of the umbilicus; and in the latter, to the fact that the gall bladder normally comes into contact with the posterior aspect of the anterior abdominal wall in the right hypochondriac region, immediately below the ninth costal arch, and when it becomes enlarged and inflamed it tends to become adherent to this area. When the aperture is situated between the ribs or costal cartilages, it is due either to an abscess having opened on the surface in that position, or to the fact that a perforating injury has been inflicted there. External biliary fistulæ usually have only one aperture, but it occasionally happens that two or more openings are met with.

*Symptoms.*—Every case of external biliary fistula is characterised by the presence of one or more apertures upon the external surface of the body, and situated in one of the regions which have been mentioned above, and from these apertures there exudes a fluid which consists either of pure bile, or of purulent matter mixed with bile, or blood mixed with bile, or with both and pus; or the fluid may consist of either pus or mucus or muco-pus, in those cases in which the fistula communicates with the cavity of the gall bladder, and the lumen of this viscus has been shut off from its normal communication with the bile duct by the obliteration of the canal of the cystic duct. Gall stones may be discharged through the fistulous aperture, and cases have been recorded in which a hundred or more calculi have been extruded in this manner. The amount of fluid which is exuded from the opening of the fistula varies considerably, and this variation is due to the condition of the other portions of the biliary ducts. When the cystic duct is occluded, the amount which is discharged is small, whilst it consists of mucus, of pus, or of muco-pus. If the cystic duct is patent, the common bile duct occluded, and the fistula communicates with the cavity of the gall bladder, large quantities of more or less pure bile will be passed. The quantity which may be discharged in this way may be several pints daily. In this class of case, it generally happens that severe jaundice precedes the formation of the fistula, a condition which disappears gradually after the fistula has been established. When the common bile duct is occluded, and there is no communication between the other portions of the bile ducts and the alimentary canal, no bile will be found in the alvine evacuations. In those cases in which the common bile duct is patent, it rarely happens that much bile passes through the fistulous aperture, owing to the fact that the greater part passes along the bile duct into the duodenum. If the entire amount of bile secreted by the liver is discharged through the fistula, the patient usually emaciates, and sooner or later dies, unless measures are adopted which establish a canal for the passage of bile into the intestine. When the fistula develops as the result of an inflammatory condition induced by the presence of gall stones, attacks of colic and pain in the hepatic region of the abdomen precede the formation of the fistula; after this has been established, improvement in the general condition of the patient usually occurs, whilst in those cases in which the gall stone is extruded through the fistulous opening the patient may recover completely and the fistula close spontaneously. If the fistula is dependent upon malignant disease of the gall bladder or bile ducts, cancerous cachexia will usually become manifest, and the patient die at an early period after the fistula has become established. The external aperture of the fistula may be situated, as we have already seen, in various parts of the abdomen and thorax, and the length of the sinus is dependent upon the distance of this external aperture from the gall bladder or the liver. In many cases the fistulous canal has a tortuous course through the overlying tissues betwen the biliary system and the surface of the body.

*Diagnosis.*—When an aperture or opening is situated upon the external surface of the body in one of the regions which have been enumerated above, and from this opening there exudes either bile or a fluid which is mixed with bile, the diagnosis of the pathological condition is easy and certain. In those cases in which the fistula is in connection with the liver, the amount of the fluid which is discharged will, in most patients, be found to be small, and to consist of purulent material mixed with a small quantity of bile, and possibly some blood; whilst if it is in connection with the gall bladder or one of the larger biliary ducts, the discharge will consist of bile or bile mixed with muco-pus. In the latter class of case it occasionally happens that calculi which have the composition and structure of gall stones, are found in the exudate. When the discharges from the fistula consist of mucus or muco-pus, and the tract of the sinus leads towards the region of the gall bladder, it is probable that the cavity of the gall bladder communicates with the sinus, and that the lumen of the cystic duct has become obliterated either by fibrous constriction or by the impaction of a calculus. In those cases in which the walls of the sinus are thickened and hard on palpation, and the surrounding tissues infiltrated with a similar hard substance, the existence of malignant disease of the gall bladder will be suggested, especially when this hard infiltration extends into the region of the normal gall bladder, and is associated with the occurrence of a cancerous cachexia. In the majority of cases where the sinus has resulted from some variety of traumatism, it will be found that it is in connection with the hepatic substance; whilst if it is dependent upon an inflammatory process, or upon the occurrence of malignant disease, the gall bladder or the biliary ducts will be the seat of the primary affection. It occasionally happens, however, that the sinus follows an abscess of the liver. When the formation of the sinus is due to actinomycosis of the liver, the characteristic yellow granules of actinomyces, which microscopically are found to contain the mycelium and spores of the ray fungus, will be found in the fluid which is discharged.

*Treatment.*—External biliary fistulæ present many difficulties in their satisfactory surgical treatment. In all cases the neighbourhood of the external aperture must be kept scrupulously clean, so as to prevent as far as possible any collection of purulent material which may act as a further irritant and aggravate the pathological condition. If a calculus can be felt to be impacted in the sinus, it should be removed at once, either simply through the external aperture, or by opening up the sinus by a surgical operation, if this is found to be requisite. In those cases in which the sinus leads towards the gall bladder, and there is only a small amount of fluid exudation, the neighbourhood of the organ must be examined ; and if it is found to be shrunken or almost obliterated by the contraction of fibrous tissue, and to be represented by a small sac with thickened and contracted walls, removal of the diseased structure should be effected by performing the operation of cholecystectomy. In many of the cases of this nature, small calculi are found to be embedded in the mass of contracted fibrous tissue, and these concretions are important factors in keeping up the constant condition of chronic irritation which results in the continuous discharge of purulent exudation from the external opening of the fistula. When it is impossible to remove the contracted gall bladder completely, or if it seems likely that the organ may regain its normal physiological functions, all concretions which may be present in the sinus, the gall bladder, or the cystic duct, should be removed, and the cavity of the gall bladder irrigated with an antiseptic solution and drained by the introduction of a small rubber drainage-tube. If the communication between the cavity of the gall bladder and the lumen of the cystic duct has been destroyed, the gall bladder should be removed in every case where it can safely be done. When large quantities of bile issue from the fistula, it is found that in most cases some kind of obstruction, complete or partial, to the flow of bile along the common bile duct exists. In these cases a thorough examination of the course of the common bile duct must be made, and any abnormal condition which is discovered must be dealt with in an appropriate manner. Thus, if a calculus is found to be impacted in the common duct, it must be removed, either by direct incision of the duct, or by forcing it onwards into the duodenum or backwards into the region of the gall bladder, whence it can be easily extracted. When a stone is found to be the cause of obstruction in the common duct, and it can be removed, this procedure will be followed in most cases by a cure. When, however, the common bile duct is obliterated by an impermeable fibrous constriction, the only chance of permanent cure which remains open is the possibility of establishing an anastomosis between the lumen of the gall bladder, or that of the dilated upper portion of the common bile duct proximal to the stricture and the cavity of the adjacent portion of the alimentary canal. This can be done by performing the operation of cholecyst-enterostomy or cholecyst-duodenostomy. When a communication of this kind has been successfully established, the external aperture of the fistula will usually close spontaneously. In cases of carcinoma of the gall bladder which have given rise to the development of an external biliary fistula, owing to adhesion of the diseased structure to the anterior abdominal wall and subsequent perforation on account of ulceration and the formation of an abscess, it is rarely feasible or possible to give any permanent assistance by the performance of a surgical operation. If, however, it is found on examination that the pathological process is localised to the gall bladder and the walls of the sinus, an attempt may be made to remove the sinus with its infiltrated walls, together with the diseased gall bladder. When the fistula is in communication with the hepatic substance, and is dependent upon a pathological condition of this organ, the external aperture of the sinus should be kept very clean and open, and in many cases of this kind it will be found that the fistulous track will gradually close. In some cases, however, in which the above method of treatment is not followed by a good result, it is advisable to slit open the sinus to its base, to scrape its walls and bottom thoroughly, and then to pack it with tampons of sterilised gauze which are daily renewed, or to insert a small rubber drainage-tube which is gradually shortened. These cases of external biliary fistulæ terminate in most instances in a permanent cure.

*Prognosis.*—Those cases which are due to the presence of gall stones, or dependent upon inflammatory processes which have resulted from them, are generally amenable to direct surgical interference, and present a very good chance of permanent recovery. In some of these cases, however, when the gall stones have caused a complete obliteration of the common bile duct, the prognosis is not so hopeful. When the fistulæ result from an hepatic abscess which has either been treated surgically, or has opened spontaneously upon the surface, the prognosis depends upon the depth, situation, and size of the abscess. Thus, when the abscess has been small and more or less superficial, the sinuses and fistulæ in most cases can be induced to close by one of the methods mentioned above; but when the abscess has been large, and has been situated in the deeper portion of the liver, then the sinuses may resist all forms of treatment, and, after lasting for many years, ultimately cause the death of the patient, owing to the occurrence of amyloid disease or to the development of fresh abscesses. When the common bile duct has become the seat of an impermeable fibrous stricture, and a cholecyst-enterostomy can be successfully performed, a permanent cure may be hoped for. Carcinoma of the gall bladder which has resulted in the formation of an external biliary fistula, owing to an extension of the disease, is probably in the great majority of cases fatal, although it is possible in a few cases to afford relief by an extensive surgical operation. Points in favour of this are the slowness of growth of a carcinoma of the gall bladder, and the rarity of cases in which the disease causes the development of secondary growths in the liver in the early stages of the affection. When the fistula is dependent upon actinomycosis of the liver, the prognosis is almost hopeless, since in this disease, if the liver is affected, the case nearly always goes on to a fatal termination.

INTERNAL BILIARY FISTULÆ.—An internal biliary fistula is an abnormal communication between the lumen of the gall bladder or one of the bile ducts, and that of some portion of the alimentary canal or other hollow viscus. It is caused in nearly all cases, either by the perforation of a gall stone or by the extension of a carcinoma of the gall bladder or bile ducts to the adjacent portion of the stomach or intestine. A fistulous communication between the gall bladder or one of the bile ducts and one of the hollow abdominal viscera, may be established as the result of an adhesion having formed between the external surfaces of approximated viscera, owing to the inflammation which is induced by the presence of a calculus. The constant irritation of this calculus gives rise to the development of an ulcerative process which terminates in the passage of the calculus from the cavity of the gall bladder or biliary duct to that of the organ to which it has become adherent. In this manner fistulæ have been established between the gall bladder or the biliary ducts and the stomach, colon, duodenum, left pleural cavity, pelvis of the right kidney, vagina, portal vein, and encysted peritoneal cavities which have been formed by adhesions. In a manner similar to the above, carcinoma of the gall bladder or the bile ducts may extend to some part of the alimentary canal, and by a process of ulceration form a fistulous communication.

*Symptoms.*—The symptoms of these fistulæ are very obscure, but in rare cases a gall stone may pass in this manner into the intestine and cause acute or chronic intestinal obstruction, which necessitates for its relief the performance of a laparotomy and the removal of the calculus from the seat of the obstruction. Occasionally a gall stone of large size is extruded per anum, and when this is the case the assumption can be made that a fistula must have been formed so as to allow the passage of the stone from the gall bladder into the intestine, since it is too large to have passed by the cystic and common bile ducts. It is not generally possible to diagnose the existence of abnormal communications between the gall bladder or bile ducts and one of the hollow abdominal viscera. In a few cases gall stones have been the cause of the formation of encysted peritoneal collections of fluid which have contained calculi, owing to the passage of these bodies through the walls of their containing organ into the adjacent part of the peritoneal cavity. If an encysted peritonitis of this kind is operated upon, the fistulous communication may be found and closed. If it is found to be impossible to close the fistulous opening in the gall bladder, it may be requisite to remove the entire organ. Carcinoma of the gall bladder or biliary ducts, which has given rise to the formation of fistulous communications with the adjacent viscera, in the great majority of instances does not admit of surgical treatment, on account of the extensive connections of the disease.

Since the diagnosis of these cases is so difficult, and in nearly all cases very uncertain, no definite indications can be given concerning the methods which should be adopted in their treatment. In most cases, however, it will be found that, even if the exact nature of the affection can be diagnosed, little can be done in the way of surgical treatment.

# CHAPTER XXIII.

## GALLSTONE ILEUS OR INTESTINAL OBSTRUCTION DUE TO GALL STONES.

Gallstone ileus, or intestinal obstruction due directly to one or more gall stones, or indirectly to an abnormal state induced by the presence of these concretions, is a pathological condition only very occasionally met with. Several varieties of intestinal obstruction caused by cholelithiasis have been described, the distinctions between the separate forms being dependent upon the manner in which the obstruction to the lumen of the affected portion of the alimentary canal has been produced. In most cases the obstruction is acute, but a form of chronic obstruction may develop as a sequel of chronic inflammatory processes which have terminated in the formation of numerous fibrous adhesions, one or more of these having involved the alimentary canal. The commonest form of obstruction is due to the impaction of a gall stone in some part of the intestine. When a gall stone becomes impacted in this manner, it is usually found that the concretion has gained an entrance into the alimentary canal by passing from the cavity of the gall bladder, where it has been formed, into the interior of an adjacent loop of intestine, through an abnormal aperture which has arisen as the result of inflammatory and ulcerative processes. The presence of a large calculus within the bladder may be associated with the occurrence of an inflammatory condition of the mucous membrane which spreads through the walls of the viscus, and causes a localised form of peritonitis and the development of adhesions between the gall bladder and a coil of intestine. When the gall bladder and intestine have become adherent in this manner, the gall stone may cause ulceration and perforation of the septum which separates the cavity of the gall bladder from the lumen of the adherent portion of the intestine, and through the aperture which is thus produced the gall stone may pass into the interior of the bowel, where, sooner or later, it may become a cause of obstruction owing to impaction taking place. Impaction of a gall stone may occur in different parts of the intestine, and may be dependent upon several causes. In some cases the large size of the calculus is the immediate cause of the obstruction; in others, a kink or abnormal bend of the intestine, which is due to the presence of a fibrous band exerting tension or pressure from the exterior; in others, the presence of a fibrous stricture, or a stricture which is due to some form of new growth; and in others again, the deposit of solid material upon the exterior of the calculus, from the contents of the alimentary canal, as a result of which it increases in size, is the determining factor in the causation of the arrest and impaction of the calculus. The part of the intestine in which the calculus becomes impacted varies to a certain extent according to the situation of the aperture through which the calculus has passed from the gall bladder. In most cases this aperture is located in some part of the small intestine, often the duodenum or the upper portion of the jejunum, but it is not uncommon to find that the transverse colon is the seat of the fistulous communication. The impaction usually takes place in the lower portion of the ileum, or at the ileo-cæcal valve, and only rarely in some part of the large intestine. Out of thirty-five cases of intestinal obstruction due to the impaction of gall stones, which have been analysed by Lobstein,[1] the seat of the impaction was at the ileo-cæcal valve in seven cases, the lower portion of the ileum in ten cases, the upper part of the ileum in six cases, the jejunum in seven cases, the duodenum in two cases, and in the colon or rectum in three cases. A gall stone has been found in a coil of intestine which has formed the contents of a hernial sac, and has been the cause of obstruction. When intestinal obstruction is due to an impacted gall stone, the obliteration of the lumen of the affected portion of the intestine is caused by a blocking of the interior by the calculus itself, and it is not due to the establishment of strangulation, such as occurs in a case of strangulated hernia. The gall bladder is not invariably the seat of the perforation, and it occasionally happens that a gall stone is arrested in the cystic duct or the common bile duct, this portion of the duct becoming dilated, inflamed, and adherent to a coil of intestine, in which case an abnormal aperture may be formed as a result of ulceration, and the calculus pass into the interior of the adherent portion of the bowel. In other cases the bile ducts become considerably dilated, so as to allow the passage of large calculi along them into the interior of the duodenum. Gall stones which have passed into the intestine in either of these ways may become arrested and impacted in their passage along the intestine, and so be the cause of intestinal obstruction. It must not be thought that when a gall stone passes into the intestine by one of the routes which have been mentioned, that intestinal obstruction is a common result. It is probable that in nearly all cases in which the calculi pass along a dilated common bile duct into the duodenum, they are extruded from the anus along with the fæces; but it is possible in cases of narrowing of the lumen of the bowel by bands and fibrous adhesions, or by malignant growths, that impaction followed by obstruction may result, or the calculus may increase in size owing to the deposit on its exterior of solid matter from the contents of the bowel, and then become impacted. Calculi of a considerable size may pass along the intestine and be voided per anum, and when intestinal obstruction follows the passage of a gall stone into the intestine, there is, in most cases, some abnormal condition of the intestine at the seat of impaction, or the calculus itself is of very large size, or the patient is suffering from chronic constipation, a condition which favours arrest of the calculus, owing to the increase in size of the gall stone by deposit of material on its exterior. The size of the impacted calculus may be considerable, or it may be only of moderate or even small dimensions. In the Museum of St. Bartholomew's Hospital[1] there is a calculus which was removed by operation from a patient in whom it had caused an attack of intestinal obstruction. This calculus measured 1½ in. in length, and 3½ in. in circumference; Fig. 44 shows its shape and size. In the same museum there is a gall stone measuring 2 in. in length and 4½ in circumference, which was removed from the rectum of a patient through the anus. Both these cases recovered. The passage of a gall stone along the intestinal canal may

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[1] Lobstein, "Gallenstein-Ileus," *Beitr. z. klin. Chir.*, Tübingen, 1896, s. 390.

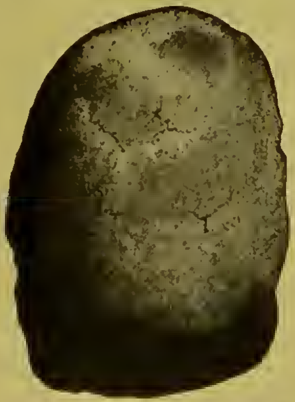

Fig. 44.—A large gall stone which caused acute intestinal obstruction owing to its impaction in the ileum. — *St. Barth. Hosp. Museum.*

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[1] *St. Barth. Hosp. Museum*, Spec. 1353.

set up irregular and violent contractions of the muscular coats, and, as a result of these contractions, a part of the small intestine may become twisted upon itself, and a volvulus of this portion of the alimentary canal induced. In most cases in which this condition arises, it is found that the calculus which is the cause of the mischief is located in the convexity of the twisted loop of intestine, although it may occasionally happen that the concretion is not included within that section of the intestine which has become twisted. It has been stated that the presence of a calculus in the gall bladder, or more especially in the cystic or common bile duct, when it is the direct cause of an attack of biliary colic, may give rise to spasmodic contractions of the small intestines, which are followed by the establishment of a volvulus, owing to a section of the tube becoming twisted upon itself, but this condition must be of very rare occurrence. Mayo Robson[1] has recorded two cases in which a volvulus of the small intestine was due to gall stones; in each case an operation was performed (the volvulus was untwisted), and the patient recovered. The occurrence of localised peritonitis in the region of the gall bladder, owing to the presence of calculi within this viscus, has been said to cause an attack of acute intestinal obstruction, by the inflammatory condition extending to a section of the adjacent portion of the alimentary canal, and causing a temporary paralysis of the muscular coats of the involved part of the intestine. It is somewhat doubtful whether this is the true explanation of this pathological condition. In cases of this kind which have been submitted to operation, it has generally been found that the structures in the region of the gall bladder and the common bile duct have been firmly bound down to one another by fibrous adhesions. It appears to be more probable that in these patients a small calculus passes along the bile duct into the alimentary canal; and when this concretion arrives at that portion of the intestine which is involved in the fibrous adhesions, a temporary arrest occurs which causes the development of symptoms of intestinal obstruction, but when the kink which causes the arrest becomes obliterated or diminished, the calculus passes onwards and is ultimately voided per anum. Several calculi may be passed in close succession from the gall bladder or bile ducts into the intestine, and form a conglomeration of calculi and intestinal contents, which conglomeration may be broken up and the obstruction set free. In that form of chronic intestinal obstruction which develops as the result of fibrous bands and adhesions which have been formed after a localised peritonitis, due to inflammation spreading from a gall bladder, the seat of calculi can only be diagnosed with very great difficulty, and its consideration is best included in a book dealing with the different forms and varieties of intestinal obstruction.

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[1] Mayo Robson, *Med.-Chir. Trans.*, London, 1895, p. 117.

*Symptoms.*—The symptoms of an attack of intestinal obstruction due to gall stones do not differ in any essential respect from those which are dependent upon intestinal obstruction caused by other pathological conditions. Abdominal pain is often an early symptom, and becomes apparent soon after the establishment of the obstruction. It is usually referred to the right inguinal region, or to the position of the duodenum, more commonly the former, on account of the frequency of impaction of the calculus in the lower part of the ileum or the ileo-cæcal valve; but it may be experienced in any part of the abdomen. Vomiting frequently occurs, the nature of the ejecta varying according to the situation of the obstruction in the intestine. When the impacted gall stone is located in the duodenum or the upper portion of the small intestine, the vomiting is usually profuse, and the vomited matter contains a considerable proportion of bile. If the pylorus is obstructed, acute dilatation of the stomach may result at an early stage of the affection. Hæmatemesis may occur if a calculus has ulcerated its way through into the stomach or upper portion of the duodenum, especially the former, the blood coming from the vessels in the margins of the fistulous aperture. The vomiting rarely becomes fæcal in character in those cases in which the obstruction is situated in the duodenum or the upper portion of the jejunum. When the obstruction involves the lower part of the ileum, or some part of the large intestine, the vomiting usually commences somewhat later; whilst the vomited material at first consists of the contents of the stomach, then of bile or bile-stained matter (when bile is passing into the duodenum), and then it becomes feculent. Constipation is an important symptom, and comes on soon after the commencement of the obstruction. There may be, however, one or two evacuations of the rectum after the other symptoms of obstruction have become established. Naunyn says that in his experience flatus is more commonly passed in intestinal obstruction which is due to an impacted gall stone, than when it is dependent on other causes. The circulation in the blood vessels of that portion of the intestine which is the seat of the obstruction is not seriously impeded in most cases of obstruction of this kind, especially in the early stages, and this may explain the frequency of the passage of flatus, and also of the contents of that portion of the intestine which lies distal to the obstruction. Diarrhœa may be present in cases in which the obstruction is not complete, but this condition is of very rare occurrence. Palpation of the abdomen may reveal the presence of a localised swelling or tumour, or of one or more areas which are tender or painful. The tumour, when present, is most commonly found in the region of the right inguinal fossa, or below and to the right of the umbilicus, owing to the fact that the lower portion of the ileum or the ileo-cæcal valve is the commonest seat of the impacted calculus. It is, however, only in occasional cases that a tumour of this kind can be felt. Dessauer, Köstlin, Jeaffreson, and Sick have described such cases. The size and shape of the tumour depends upon the characters of the calculus and the contents of the intestine in the region of the impaction. When the obstruction is due to the impaction of a calculus in the lower portion of the sigmoid flexure, or in the rectum, it will be possible to detect its presence by a digital examination per anum. Distension of the abdomen is a frequent symptom, and is due to an accumulation of gas and fluid intestinal contents in that portion of the alimentary canal which is proximal to the obstruction. It is limited to the epigastric and left hypochondriac regions in those cases in which the obstruction is situated in the duodenum or the upper portion of the jejunum, the other parts of the abdomen being retracted. When the lower part of the ileum or the ileo-cæcal valve is the seat of the impacted gall stone, the distended intestines occupy the inferior and anterior portions of the abdomen; whilst, if the obstruction is in the sigmoid flexure, there is a general distension of the entire abdomen. If, during the passage of the gall stone from the biliary system into the intestine, a communication is established between one of the hollow viscera and the peritoneum, infection will usually occur, and be followed by the development of acute peritonitis, and the appearance of symptoms which are characteristic of this condition. Such a complication is rare in the early stages. When, however, the obstruction has lasted for some time, and the portion of the intestine which grasps the calculus has become ulcerated and gangrenous, then perforation and septic peritonitis are very likely to happen.

A biliary calculus may remain in the intestinal canal for some time without giving rise to the development of symptoms from the presence of which its existence can be diagnosed. Smith has recorded a case in which the calculus probably passed into the intestine from the gall bladder fifteen years before the occurrence of obstruction. Eve has also published a somewhat similar case. Usually obstruction comes on within a short period from the time when the calculus has gained an entrance into the interior of the alimentary canal. It rarely happens that a calculus causes obstruction when it has passed along the common bile duct into the duodenum, since these calculi are of small size and can easily pass along the intestine, and be voided along with the fæces. Several small calculi may, however, become united together by the contents of the intestine, and then increase in bulk by the deposition upon their exterior of solid constituents derived from the food. A single calculus may increase in size in a similar manner, and so become a direct cause of obstruction.

Thorowgood[1] has described the case of a girl, æt. 10, in whom an abscess formed in the right groin, and from this a small gall stone, consisting of cholesterin, escaped when an incision was made to evacuate the collection of pus. It is probable that in this case a gall stone had passed from the biliary duct into the intestine, and thence into the vermiform appendix, where it gave rise to inflammation, suppuration, and the development of an abscess which pointed in the groin. The patient recovered.

It occasionally happens during an examination of the abdomen, that the impacted calculus which is the cause of the obstruction becomes dislodged, and passes onwards to be voided per anum. The symptoms of obstruction in these cases at once become less marked, and soon disappear. Schüller[2] has described four cases of this nature, in each of which relief followed a manual examination, and a short time afterwards a calculus was found to have been discharged with the fæces.

Intestinal obstruction dependent upon gall stones occurs much more frequently in women than in men. According to Naunyn,[3] it is five times more frequent in women than in men.

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[1] Thorowgood, *Trans. Path. Soc. London*, 1877, p. 130.

[2] Schüller, "Gallensteine als Ursache der Darmobstruktion," Inaug. Diss., Strasburg, 1891.

[3] Naunyn, *loc. cit.*

In Lobstein's[1] statistics, out of sixty-six cases in which the sex was stated, forty-six were females; and in Schüller's table there are 74 per cent. of women (139 cases). The majority of cases occur in individuals who are over 40 years of age; this is to be expected, since gall stones are more common after this age. In a hundred and eight of Schüller's cases in which the age was stated, four occurred under 30, five between 30 and 40, and ninety-nine after 40. Out of forty-nine cases collected by Lobstein, thirty-one were 60 or more.

*Diagnosis.*—It is often very difficult to diagnose gall stone ileus, since in most cases the symptoms are very similar to those of intestinal obstruction due to other causes. The previous history of the patient may, however, often help in leading the surgeon to a correct diagnosis of the pathological condition. Former attacks of cholelithiasis, during which gall stones have passed from the biliary system into the alimentary canal, whence they have been extruded per anum, when a clear history of their occurrence is given, will point to the possibility or even probability of the present attack being of a similar nature; or the occurrence of one or more attacks of jaundice may have a like import. Naunyn was able to trace a connection of this kind in forty-one cases out of a total of 120. The sex of the patient is of importance, since the affection is much more common in women than in men. It is especially frequent in old women; and when an obscure case of intestinal obstruction in an old female is being examined, the possibility of the obstruction being due to an impacted gall stone must not be forgotten. The presence of a tumour which can easily be felt, in the region of the ileo-cæcal valve, will also indicate the probability of a gall stone being the cause of the obstruction. The ordinary hernial apertures should always be carefully examined so as to exclude the possibility of the obstruction being due to an external hernia. In a considerable number of the cases it is not possible to make a diagnosis of the cause of the obstruction before the peritoneal cavity has been opened and its contents examined through a median incision in the abdominal wall. When it is thought that a gall stone is the cause of an attack of intestinal obstruction, some authorities have advised that the situation of the impacted calculus should be sought for by sounding the abdomen with a long fine steel needle pushed through the abdominal wall. This is a very dangerous method of procedure, and ought never to be practised. The intestines and other important anatomical structures are liable to be injured, whilst septic material may exude from the puncture holes in the intestinal wall, and acute septic peritonitis be induced, which soon leads to a fatal termination. It is far safer in cases of this nature to open the abdomen at an early stage, and then to examine the obstructed intestine, and deal with it according to the pathological condition which is discovered.

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[1] Lobstein, *loc. cit.*

*Treatment.*—The treatment of intestinal obstruction due to gall stones may be either medical or surgical, or both. In the early stages of the obstruction it is advisable to adopt medical and palliative measures. The patient should be kept in bed and small quantities of opium administered. If the abdominal pains are severe it will be best to give a hypodermic injection of morphia. In most cases it will also be desirable to give a soap and water enema, in order to empty the lower portion of the intestine. Kussmaul has advised that the stomach should be washed out so as to avoid the absorption of the products of decomposition of the food which may be present. If a tumour can be felt through the abdominal wall, it may be advisable to manipulate it carefully, in order, if possible, to induce its movement onwards, and so remove the obstruction. Dufort recommends stimulation of the abdominal region with the faradic current in these cases, and he has published a successful case. The patient's strength should be maintained by the administration of small quantities of peptonised milk, and of brandy and other stimulants, by the mouth, if the vomiting is not too frequent, and in severe cases it may be necessary and advisable to give nutrient enemata. If measures of this kind do not quickly give rise to a disappearance of the obstruction and an amelioration of the symptoms, it will be necessary to perform a surgical operation for the relief of the patient. It is often a difficult matter to decide when to have recourse to surgical treatment, but it is much better to operate early than late, when the patient's general condition has become enfeebled and she is not capable of withstanding a severe surgical operation. In all cases of intestinal obstruction due to the impaction of a gall stone, the abdomen should be opened in the middle line when the locality of the obstruction is not known, and the situation of the impacted calculus sought for. In order to do this, it may be necessary to bring out successive portions of the intestine until the affected loop is discovered. When this has been done, the loop of intestine is brought well out through the abdominal wound and surrounded with warm sterilised compresses. An incision is then made along the convexity of the gut in a longitudinal direction, and the calculus extracted. If the gall stone is large, it may be advisable to break it up into several fragments before extraction, so as to avoid making a large hole in the intestine. When the calculus has been removed, all intestinal contents are removed from the area of the operation by washing and sponging with sterilised water or dilute aseptic solution, and then the aperture in the intestine is closed by the insertion of two or three tiers of fine silk sutures. The first tier unites the mucous membrane on each margin of the incision, the second approximates the muscular coats, whilst the third fixes in contact the peritoneal surfaces of the intestine on each side of the incision. The first tier is a continuous suture, the second is an ordinary interrupted one, and the third is inserted after Lembert's method. When this has been done, the intestine is again sponged and then returned into the peritoneal cavity, and the abdominal wound closed. When the obstruction has existed for some time, and the general condition of the patient will not permit a prolonged operation, a median laparotomy should be performed, the affected portion of intestine brought into the wound and then opened, the margins of the incision in the gut being fixed to those of the external wound. In this manner an artificial anus is established, and if the condition of the patient improves this may be closed at a later period. In those cases in which a perforation of the intestine has been formed, or in which there is a communication between the interior of the bile passages and the peritoneum, the perforation must be sought for and closed, and then the peritoneal cavity irrigated, so as to remove as far as possible all septic matter and prevent the development of acute peritonitis. If peritonitis has become established, a similar method of treatment should be adopted, and the peritoneal cavity drained. When the intestine in the region of the impacted calculus has become gangrenous, a condition which rarely happens, it may be necessary to remove the dead portion and then to unite the two ends by some method of intestinal anastomosis. Usually, however, in cases of this kind the general condition of the patient is very serious, and it is advisable to establish an artificial anus, and if improvement occurs to unite the open ends of the intestinal loop at a later period, in this manner giving the patient a better chance of recovery. If, after the peritoneal cavity has been opened, it is found that the obstruction is of the nature of a volvulus, this should be untwisted, and, when the calculus is within the twisted loop and of small size, it should be manipulated onwards with the fingers, but if large it will in most cases be advisable to make an incision in the long axis of the bowel and opposite the attachment of the mesentery in order to extract it. The incision is closed in the manner described above. The after-treatment of all cases of gallstone ileus is similar to that of other varieties of intestinal obstruction.

*Prognosis.*—Intestinal obstruction due to a gall stone is a very serious pathological condition, a considerable number of cases terminating fatally. Lobstein[1] has collected the statistics of ninety-two cases, of which thirty-one were submitted to a surgical operation, and sixty-one were treated by medical measures alone. Twelve of the cases operated upon recovered, and nineteen died, whilst of those not submitted to operation thirty-two recovered and twenty-nine terminated fatally. The percentage of recoveries in these cases was 38·7 for those operated upon, and 52·4 for those treated by medical measures only. According to Courvoisier, the mortality is 44 per cent. (125 cases), while Schüller places it at 56 per cent. (82 cases). In these cases, however, the operation cases are not separated from the non-operation ones. Mr. Jonathan Hutchinson says that the mortality in those cases which are treated surgically is about 50 per cent., and he thinks that the question of the advisability of a surgical operation in intestinal obstruction, due to an impacted biliary calculus, is not yet definitely decided.

When a person has suffered from one attack of intestinal obstruction, caused by the arrest of a gall stone in the alimentary canal, and has recovered from it, he is always liable to have a recurrence of the affection, caused by another calculus passing from the bile passages into the intestine, and becoming arrested at the ileo-cæcal valve or other part of the course of the alimentary canal towards the anus.

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[1] Lobstein, "Zur Kasuistik des Gallenstein-Ileus," *Beitr. z. klin. Chir.*, Bd. xiii. s. 406.

# CHAPTER XXIV.

## OPERATIONS UPON THE LIVER.

*Aspiration.*—The aspirator can only be made use of, in the treatment of pathological conditions of the liver, under restricted circumstances. It is very useful in the diagnosis of the character of the contents of an obscure collection of fluid, but its application in this respect should be very limited. The strictest antiseptic precautions should be practised in every case in which the needle of an aspirator is used to explore a hepatic swelling. The skin over the affected area must be rendered free from septic micro-organisms, by washing it with soap and water, ether, and finally with a solution of perchloride of mercury (1 in 500), before a puncture is made. Before introducing the needle, it is essential to have it carefully boiled, so as to render it aseptic. It is plunged inwards over the most prominent portion of the swelling. Some authorities have recommended that the needle should be filled with a solution of carbolic acid (1 in 20), but it appears to me that careful boiling is quite sufficient. When the collection of fluid has been reached, the point of the needle should be permitted to move with the liver during respiration, so as to avoid unnecessary laceration of the hepatic substance along the line of puncture; since, when this happens, the escape of pus or other fluid into the adjacent portion of the peritoneal cavity is facilitated. After the point of the needle has entered the abscess or cyst, a small quantity of the fluid can be withdrawn and examined, and its nature determined. Some surgeons have advocated the treatment of hepatic abscesses by aspiration and removal of the pus through the needle. When this treatment is adopted, it is generally necessary to perform aspiration several times before a cure is effected. Many cases of failure, however, have been reported, and it has been found that septic peritonitis may result, owing to the escape of pus along the tract of the needle into the peritoneal cavity. On account of the liability to failure and the occurrence of septic peritonitis, and also the possibility of injury to one or other of the neighbouring abdominal viscera, it is advised that an abscess of the liver should not be treated by aspiration alone. When the situation of the pus has been determined by the aspirator, an incision should be made into the pus-containing cavity, the contents evacuated, and the interior drained after the manner described in a succeeding paragraph.

Some authors have advised that non-suppurating hydatid cysts of the liver should be treated either by simple puncture, or by puncture, withdrawal of a small quantity of the fluid contents, and injection of tincture of iodine, perchloride of mercury, or other drug. The advisability of the performance of these procedures is discussed in the chapter on hydatids.

*Puncture.*—Puncture by a trocar and cannula, the cannula being left in so as to allow drainage, has been recommended by different surgeons, but, owing to the serious complications which are liable to occur as the result of this method of treatment, the operation is now very rarely, or practically never adopted. Unpleasant results are liable to follow the use of the trocar similar to those which have been mentioned in connection with the use of the aspirator; but since the trocar is much larger than the needle of an aspirator, leakage along the tract of its entrance more frequently happens, and on this account its use is said to be more dangerous. When an abscess of the liver is tending to point on the surface of the body, a trocar is a very useful instrument for its puncture and evacuation; but in cases of this kind it must be remembered that even when an abscess is apparently close to the surface, that portion of the peritoneal cavity which intervenes between the surface of the affected part of the liver and the adjacent portion of the abdominal wall, may not have been obliterated by the formation of inflammatory adhesions, and consequently pus may escape into the peritoneum. A trocar is a most valuable instrument for the location and partial evacuation of an abscess or cyst of the liver, after the surface of the gland has been exposed by an incision, and it is to this class of case that the use of the trocar should be restricted.

*Hepatotomy.*—By the term hepatotomy is generally understood the making of an incision into the liver; and hence the operation which is designated by this name has for its object an incision into the hepatic substance. This surgical procedure may be performed in a variety of ways, but in all cases it is necessary to make an incision through the overlying parietes before the liver itself is reached. The following are the different methods which have been employed in the performance of hepatotomy:—

(*a*) *Direct incision extending into the liver.*—This operation can only be performed when the peritoneal surface of the liver has become adherent to the parietal peritoneum which covers the posterior or deep aspect of the adjacent portion of the anterior abdominal wall, and that part of the peritoneal cavity which intervenes between the surface of the liver and the abdominal parietes has become obliterated. In the case of abscesses of the liver which are pointing on the surface of the body, and are accompanied by the appearance of redness, œdema, tenderness, and superficial fluctuation over the most prominent part of the abdominal swelling, it may be assumed in most instances that adhesions have been formed as the result of the inflammatory process, and that there is no risk of opening and contaminating the peritoneal cavity. The above clinical appearances may, however, be present in cases of abscess of the liver, without the simultaneous obliteration of the overlying portion of the peritoneum by the formation of adhesions; hence, when cases of this nature are being operated upon, it is necessary to proceed cautiously, in order to ascertain whether or not adhesions have been formed. In performing the operation, an incision, which is about one and a half to two inches in length, is made over the most prominent portion of the swelling, the direction of the cut in most cases being vertical to the long axis of the body; this incision is extended carefully through the tissues of the abdominal wall, until the surface of the liver is reached. If it is found that adhesions have been formed which shut off the whole length of the incision from the adjacent part of the peritoneal cavity, the liver substance is at once incised, until the abscess cavity, hydatid cyst, or other pathological focus is reached. In most cases this variety of operation is performed for abscess of the liver or hydatid disease, and when the affected portion of the viscus is met with, it is cut into, and then the margins of the wound are held well apart, so as to allow the contents of the cavity to escape. After the swelling has been evacuated in the above manner, the interior is carefully examined with the forefinger. If other abscesses can be felt in the neighbourhood of the one which has been opened, the intervening liver tissue is broken down with the finger, and the contents are allowed to pass out through the opening in the abdominal wall. Great care must be taken in breaking down the hepatic tissue with the fingers, so as to avoid the rupture of any large branch of the vessels within the liver, which might lead to the occurrence of severe hæmorrhage. If the contents of the swelling do not readily pass out through the wound when the margins are held apart, it will be advisable to apply manual pressure to the abdomen in the region of the wound, and at the sides of the swelling in the liver. After an abscess of this kind has been evacuated as far as possible, the cavity should be irrigated with warm sterilised water, or a dilute solution of perchloride of mercury (1–2000), so as to remove any débris and other septic matter which may have been left at the bottom or in the recesses of the cavity. If hæmorrhage occurs, irrigation with water at a temperature of 112–115° F. will help in its arrest. After the irrigation has been carried out, a moderate-sized red rubber drainage-tube, which has a number of perforations in its deeper part, is inserted into the bottom of the abscess cavity, and an aseptic absorbent dressing not too tightly applied.

This operation can only be performed in those cases of abscess or hydatid cyst of the liver in which the diseased part of the organ has become directly fixed to the parietal peritoneum and the abdominal wall, by the formation of fibrous adhesions which completely shut off the area of operation from the peritoneal cavity. When this is the case, the possibility of the occurrence of septic peritonitis, as the result of contamination of the peritoneum with the contents of the abscess, are very much diminished, and hence the prognosis is better as regards recovery.

(*b*) *Immediate incision by an abdominal operation.*—In this operation the abdominal wall and the liver are incised at the same sitting, and in addition any other treatment which may be requisite is done at the same time. A vertical incision is made over the most prominent portion of the hepatic swelling, commencing above at the costal margin, and extending downwards for three or four inches. When the peritoneum is reached it is divided for the whole length of the incision. The surface of the liver will then be seen at the bottom of the wound, and the situation of the enlargement should be made out. In many cases the surface of the enlarged portion will tend to protrude at the bottom of the wound. That part of the peritoneal cavity which is in the neighbourhood of the liver is next carefully packed with flat aseptic sponges (which are counted and a record of their number kept), so that any fluid which may escape from the liver during the later stages of the operation may be prevented from passing into the general peritoneal cavity to become a cause of peritonitis. After the sponges have been introduced, pressure is applied to the external surface of the abdomen, by the hands of an assistant, so as to keep the abdominal parietes in close apposition with the sponges, thereby preventing the passage of any extraneous matter into the peritoneum. In the case of an abscess, an exploring syringe with a long needle of moderate calibre is pushed into the liver substance, and the locality of the pus is sought for. When this has been found, an incision is made into the liver tissue about one and a half or two inches long, parallel to the margins of the abdominal wound. This is deepened until the abscess is reached. If there are any bleeding points in the hepatic substance, they are picked up with artery forceps and ligatured with fine silk. The aperture which is made into the abscess is kept open by the introduction of a pair of dressing-forceps (the blades being separated), and the purulent contents allowed to exude. If any difficulty is experienced owing to the liver showing a tendency to recede, the forefinger may be passed into the cavity of the abscess, and the liver hooked forwards by exerting traction with the bent finger. If the forefinger is not used in this way, two strong silk sutures may be passed through the margins of the hepatic wound, and given to an assistant to hold. By exerting traction upon these, the margins of the wound in the liver may be kept in close apposition to the abdominal walls. In this manner the abscess can in most cases be readily evacuated; but if the pus exudes slowly, a large rubber tube may be passed into the abscess cavity, and the outer end pinched and depressed so as to make it act as a syphon, or a glass syringe may be fixed to the outer end of the tube, and the pus withdrawn into the syringe. After the cavity has been emptied in this manner, the interior is examined, as described above, and if any other abscesses are present they are made to communicate with the one which has been first opened. When the evacuation is complete, the cavity is irrigated, and the aperture of the wound in the liver is temporarily closed by the insertion of a sponge, which acts as a plug. All traces of pus and débris are now removed from the tract of the incision and from the exposed surface of the liver, by irrigation and sponging, and then the sponges which have been placed in the peritoneum for packing are removed and counted. If there has been any escape or soaking of pus into the peritoneal cavity, the soiled area is thoroughly irrigated with warm sterilised water or some antiseptic solution. The margins of the hepatic incision are now united to those of the incision in the abdominal parietes. Silk sutures are used, which are introduced by a modification of Hagedorn's needle, which in shape is fully curved and the point flattened (Fig. 49). Each suture is first introduced at the deeper part of the hepatic incision, and then is carried through the liver tissue, and the point of the needle made to emerge upon the surface of the gland, about one-third or one-half of an inch from the margin of the wound; and then the same suture is carried through the abdominal wall and made to emerge through the skin of the abdomen, about one-third of an inch from the margin of the parietal wound. The sutures are introduced at intervals of one-third of an inch for the entire length of the hepatic incision, all sutures being introduced before any are tied. At the upper and lower extremities of the hepatic incision, a suture is passed through the abdominal wall on one side of the wound, then through the liver tissue just beyond the angle of the wound, and finally through the abdominal wall upon the other side. The portion of the abdominal incision which lies above and below these sutures, is closed by the approximation and fixation of its margins in the usual fashion. After all the sutures have been introduced they are tied, those which pass from one side to the other being tied last of all. When all the sutures have been tied and their ends cut short, the sponge is removed from the cavity of the abscess, and a large drainage-tube inserted, and fixed so as to prevent it slipping into the cavity of the abscess. Care should be taken that the drainage-tube is not too long, as, if this is the case, the pressure necessary to fix the dressings may drive it into the substance of the liver, and give rise to severe hæmorrhage. Thick absorbent aseptic dressings are applied after the drainage-tube has been inserted.

Fontän[1] recommends that the walls of the hepatic abscess should be well curetted whilst the irrigation is being carried out.

When this form of operation is carried out for the treatment of hydatid, the parasitic cyst usually protrudes into the wound after the abdominal cavity has been opened, and an incision can be at once made into the liver substance without first using an exploring needle in order to find out the locality of the disease, since in most cases these cysts can be seen projecting from the surface of the liver.

(*c*) *Incision in two stages* (*à deux temps*).—The early stages of this operation are exactly the same as those in the preceding one, until the peritoneal cavity has been opened and the surface of the liver exposed. When this has been done, an area of the liver, about one and a half or two inches long and half an inch wide, is selected (for the site of the future incision), and with a fully curved Hagedorn's needle a series of interrupted silk sutures is introduced, each suture entering the liver substance at the margin of the selected area, passing through the hepatic tissue for a short distance, and then emerging about one-third of an inch outside its point of introduction, and finally being made to pierce the abdominal wall, as in the last operation. When all the sutures have been introduced, they are tied, and the remaining portions of the abdominal incision closed with silk sutures above and below the selected hepatic area. Moderately severe bleeding may occur from the liver at the site of the needle punctures, but this soon ceases spontaneously. By this means a portion of the peritoneum which covers the liver is closely approximated to the parietal layer which lines the posterior aspect of the anterior abdominal wall. The margins of the wound are kept apart by packing the incision with aseptic gauze, and then a dressing is firmly applied. This completes the first stage of the operation. After the expiration of three or four days the dressing is removed, and it will then be found that adhesions have been formed between the visceral and parietal layers of peritoneum, and that the general peritoneal cavity has been cut off from the wound. The exposed area of the liver is now incised until the cavity of the abscess or cyst is reached. In order to facilitate the performance of this stage of the operation, it is advisable, at the termination of the first stage, to introduce a silk suture at the upper and lower limits of the exposed area of the liver, and to leave the ends of these sutures long, so that when the incision into the liver is made they may be lifted and the cut with the scalpel made to extend between them. If a case of hepatic abscess is being treated, it is evacuated, irrigated, and treated in a manner similar to that which has been described in the last operation. It is not absolutely requisite to give an anæsthetic for the second stage of the operation, but in most cases it will be found to be advantageous to do so. Some surgeons advise that instead of suturing the liver to the parietes in the first stage, that the parietal peritoneum should be fixed to the skin by a few points of interrupted silk suture, and that the wound should then be packed with aseptic gauze, and a thick pad tightly applied, so as to bring the surface of the liver and the anterior abdominal wall as far as possible into apposition, in the hope that they will acquire adhesions. This method, however, is much more uncertain than the preceding one, and on this account it is not recommended.

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[1] Fontän, *Semaine méd.*, Paris, 1895, No. 43.

In the majority of cases of cysts or abscesses of the liver, it is advisable to adopt the method of immediate incision and drainage. Of course, if the liver has become adherent to the overlying portion of the abdominal wall, direct incision will be carried out. In cases of hepatic abscess it is not advisable, and often not justifiable, to lose several days in waiting for adhesions to form, but when the presence of pus has been definitely diagnosed it ought to be evacuated at once. In those cases of cystic disease of the liver in which suppuration has not occurred, there is no serious objection to the latter method of operation. As, however, operations can be carried out under strict antiseptic precautions and conditions, there is very little advantage to be gained by operating in two stages.

(*d*) *Incision through the thoracic walls, which is followed by incision of the liver and subsequent drainage.*—The operation of hepatotomy, when carried out through the thoracic wall, may be performed in either one or two stages, as in the case of operation through the abdominal wall.

*Operation at one sitting.*—A site is selected on that part of the thoracic wall which overlies the most prominent portion of the hepatic swelling, and an incision, three inches long, which may be lengthened if necessary during the later stages of the operation, is made parallel to a rib. The rib is exposed, the structures which are attached to it separated, and then a portion of it is excised. The underlying costal layer of the pleura is next divided and the cavity of the pleura opened, when the air rushes inwards and the lung of the corresponding side becomes collapsed. The layer of pleura which covers the adjacent portion of the diaphragm is now sought for and brought as far as possible into the wound, and an incision an inch or more in length is made into it. The margins of the wounds in the two layers of the pleura (the costal and the diaphragmatic) are closely approximated, and united with numerous fine silk sutures. At this stage of the operation it may in some cases be found necessary to aspirate the hepatic swelling and remove a portion of the fluid contents, so as to relax the diaphragm and the pleura. The diaphragm in the bottom of the wound is next incised, and sutures are passed through it so as to fix it to the margins of the wound in the thoracic wall. By these means the pleural cavity of the affected side (the right) is completely shut off from communication with the external atmosphere, and also from the swelling which is about to be incised. An incision is now made through the hepatic tissue where it is exposed at the bottom of the wound, and is deepened until the cavity of the abscess or hydatid cyst is reached. When this has been done, the abscess or cyst is evacuated and treated in a manner similar to that which has been described when the abdominal operation was under consideration. The extremities of the incision in the thoracic wall may be closed with sutures, if it is thought advisable. In order to obtain complete closure of the pleural sac, it has been recommended to apply a continuous suture to the two layers of pleura.

*Operation à deux temps.*—In this operation the early stages are similar to the preceding. When the layers of the costal and diaphragmatic pleuræ have been incised and united with sutures, the wound is plugged with aseptic gauze, and left for several days. After the expiration of three to five days, an incision is made into the liver, and the abscess or cyst opened and treated in a manner similar to the above. In most cases it will be found advisable to complete the operation at one sitting, since the parts become coated with layers of lymph, and it becomes very difficult to recognise the different anatomical structures as they lie in the bottom of the wound.

*Hepatectomy.*—It is only during recent years that surgeons have successfully removed portions of the liver by operation.

The operation has been called "resection of the liver," or hepatectomy. In those cases in which portions of the liver have been removed a fair amount of success has been met with, and it is to be hoped, by the introduction of improved details of technique, that this operation may become a recognised and justifiable one, since there are many affections of the liver which only admit of a cure being obtained by a complete and radical removal of the diseased tissue. All operations of this nature which involve the liver are limited to the removal of a portion of the organ, since it is not possible for a person or mammal to live when the entire organ has been taken away, even if this operation were possible from a merely operative point of view. The removal of portions of the liver can be effected according to one of the following methods, each of which has been used and recommended by surgeons of repute.

(*a*) *Fixation of the diseased portion of the liver in an abdominal wound and application of an elastic ligature to its base, so as to cause sloughing of the parts distal to the ligature.*—When the abdominal walls have been prepared for the performance of an aseptic operation, and the patient has been anæsthetised, an incision, from four to six inches long, is made through that portion of the abdominal wall which overlies the affected portion of the liver, commencing above at the costal margin and extending downwards in a vertical direction. This incision is deepened until the parietal peritoneum is reached, when it is divided for the entire length of the wound. All hæmorrhage from blood vessels in the incised abdominal walls is arrested, and then that portion of the liver which it is wished to remove is brought well into the wound, and made to protrude externally, so that the base of the diseased part can be brought into good apposition with the margins of the wound in the abdominal parietes. A series of silk sutures is next passed through the liver substance, well beyond the diseased area, and then through the abdominal wall a short distance from the margins of the incision, so that when these are tied the liver is firmly fixed to the abdominal wall, and the diseased portion protrudes externally. That portion of the abdominal wound which lies below the protruded part of the liver is closed in the ordinary manner with silk sutures. An elastic ligature is placed around the base of the protruded piece of liver, but distal to the ring of sutures which fix the organ to the anterior abdominal wall. This ligature is allowed to remain in position for three or four days, the area of the operation being protected by the application of aseptic dressings. About the third day the elastic ligature is replaced by a second one, which is more tightly applied, and, if requisite, this in its turn is also replaced by a still tighter one. By these means the portion of the liver which lies beyond the elastic ligature is made to undergo a necrotic change, and in a short time it becomes separated as a slough or mass of gangrenous tissue. When the constricted portion has separated from its connection with the remainder of the liver, the base of the protruded portion will cicatrise and heal. The separation of the protruded portion may be hastened by the use of the actual cautery, on the tenth or twelfth day after the application of the elastic ligature. If the gangrenous portion remains too long in connection with the liver, putrefactive changes are very liable to become established, and the abdominal wound, or the liver itself, may become the seat of suppuration. Lücke[1] has removed a cancerous mass from the left lobe of the liver by this method, and the patient recovered, whilst a similar result followed in a case of multilocular hydatid cysts, which was operated upon by Terrillon.[2] Bastianelli,[3] Hochenegg,[4] and Schmidt[5] have also operated upon the liver in this manner.

(*b*) *Fixation of the diseased portion of the liver in an abdominal wound, and removal of the affected part after the liver has become adherent to the margins of the incision* (*operation à deux temps*).—The early stage of this operation is exactly similar to that of the preceding. The portion of the liver which it is desired to remove is fixed by its base to the margins of a wound in the anterior abdominal wall, where it is left for several days or more. When the liver has formed adhesions to the margins of the abdominal wound, the second stage of the operation is performed. The portion of the liver which protrudes is detached from the remainder of the gland, either by cutting it away with a knife or with a Paquelin's cautery. As the piece of liver is removed the cut surface should be covered with a sponge, and pressure applied so as to arrest temporarily any hæmorrhage which may occur, and to prevent the possibility of entrance of air into the open mouths of the intra-hepatic veins, and thereby to avoid air embolism. When the portion of the liver has been detached the sponge pressure is relaxed, and all bleeding points upon the cut surface are ligated with silk. After hæmorrhage has been arrested in this manner, the cut surface of the organ is irrigated so as to remove all traces of blood and débris, and then an aseptic dressing is applied and is firmly fixed in position by strapping and a bandage. Müller, Tillmans,[1] and Tricomi [2] have resected portions of the liver by this method, and they speak well of the operation. In order to avoid the exposure of large cut surfaces of the liver after the resected portion has been taken away, it appears to me that in the second stage of the operation it would be preferable to resect the part of the liver which is to be removed, by the employment of a wedge-shaped incision, such as is described later. If this form of incision in the liver were adopted, it would be possible to bring together the margins of the hepatic wound, and fix them in apposition by the insertion of sutures. All fear of the occurrence of hæmorrhage and air-embolism may thus be avoided. In all cases of exposure of a cut area of the liver, great care must be taken to prevent the entrance of air into the hepatic veins, since in these structures the venous blood pressure may be negative, and air tend to be drawn inwards by suction. Some authors have recommended that, after the portion of liver has been detached with the knife, the actual cautery should be applied to the cut surface, so as to arrest hæmorrhage and prevent the occurrence of air embolism. If it is wished to make use of the cautery, it appears to me to be preferable to remove the piece of the liver with the knife of a Paquelin's cautery, and so arrest all hæmorrhage as the operation proceeds. The objection to the use of the cautery in these cases is the necessary necrosis of charred tissue which must follow, and the liability to suppuration as the dead tissue is being separated or absorbed. A number of cases have been recorded in which a portion of the liver has been protruded externally through a penetrating wound of the abdominal wall, and this protruded part has been removed, either by encircling its base

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[1] Lücke, "Entfernung des linkenkrebsigen Leberlappen," *Centralbl. f. Chir.*, Leipzig, 1891, s. 118.

[2] Terrillon, "Chirurgie du foie," *Bull. Soc. de chir. de Paris*, 1890, p. 855.

[3] Bastianelli, *op. cit.*

[4] Hochenegg, "Ein Beitrag zur Leberchirurgie," *Wien. klin. Wchnschr.*, 1890, ss. 223 and 1008.

[5] Schmidt, "Ueber Leberresection," *Deutsche med. Wchnschr.*, Leipzig, 1893. No. 8, s. 175.

[1] Tillmans, *Ber. ü. d. Verhandl. d. deutsch. Gesellsch. f. Chir.*, Leipzig, 21 Cong. s. 73.

[2] Tricomi, *Rev. de chir.*, Paris, 1894, p. 433.

with an elastic ligature and causing it to slough, or with the knife, after which the base has been cauterised to prevent hæmorrhage.

(c) *Removal of tumours and cysts from the liver by dissection, and subsequent closure of the wound in the liver by sutures, together with simultaneous closure of the abdominal incision.*—Tumours of the liver which are completely encapsuled, or hydatid and other forms of cysts which are embedded in the gland, may be removed by dissection. After the surface of that portion of the liver which contains the tumour or cyst has been exposed by an incision in the abdominal wall, the surrounding portion of the peritoneal cavity is packed with aseptic sponges, so as to avoid contamination of the peritoneum with blood or foreign material, or injury to the intestines, and then an incision is made into the hepatic substance until the superficial portion of the tumour is exposed. The tumour or cyst is then separated from the normal hepatic tissue by a process of careful dissection, and all bleeding vessels clamped and tied as the operation proceeds, so as to avoid, as far as possible, any severe loss of blood. When the tumour has been removed in this manner, and all hæmorrhage arrested, the surfaces of the wound in the liver are brought into apposition and fixed by the insertion of sutures. If the cavity extends for some distance into the substance of the gland, it is advisable that its deep parts should be approximated by the insertion of one or more tiers of buried sutures, and finally the margins of the wound on the surface of the liver are fixed in accurate apposition by the insertion of a row of fine sutures, which should not be more than one-third of an inch apart. When the incision in the liver has been treated in this manner, the organ is dropped back into the abdominal cavity, and after all sponges, blood, and other material have been removed from the peritoneum, the abdominal wound is closed in the usual manner. Great care must be taken in the performance of this operation, not to include the portal vein, or one of its large branches, within any of the ligatures or sutures. I have seen one case in which this accident happened, and the patient died a few hours afterwards from abdominal hæmorrhage and arrest of the circulation of the blood through the portal vein. Tansini[1] has recorded a case of hydatid cyst of the liver which he treated in this manner, and the patient rapidly recovered.

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[1] Fogliani, "Estirpazione totale di cisti di echinococco," etc., *Gaz. d. Osp.*, Napoli, Jan. 21, 1891, p. 45.

Bergmann,[1] Küster, and Eiselberg[2] have removed portions of the liver containing cysts and tumours in a manner resembling the above, and they recommend that a small portion of the abdominal incision should be left open, and that the cavity in the liver should be packed with a long strip or tampon of aseptic gauze, the end of which is made to pass out through the open angle of the abdominal wound. After one or two days it is removed, and the abdominal wound is allowed to close. It is thought that this precaution diminishes the liability of the occurrence of hæmorrhage from the injured area of the liver.

(*d*) *Excision of a portion of the liver by the employment of a wedge-shaped incision.*—The author has performed this operation a number of times with success in a series of investigations upon the "surgery of the liver and biliary passages," which have been carried out at the laboratories of the Royal Colleges of Physicians and Surgeons. In most cases the animals used for the experiments were cats. From the success which was met with in these experiments, and the comparative ease with which the removal of portions of the liver was effected, it seems possible that a similar operation may, in suitable cases, be made use of in man when it is necessary to remove portions of the liver. The operation is performed in the following manner:—The abdominal walls are cleansed and rendered aseptic in the ordinary manner, and then a vertical incision, 4 to 6 in. long, is made through the abdominal walls, commencing above at the costal margin and situated over that portion of the liver which it is wished to remove. In most cases it will be found that the incision can be made in either the linea alba or in the right or left linea semilunaris. The peritoneal cavity is opened for the entire length of the incision, and then the affected portion of the liver is brought out into the abdominal wound, and its base surrounded with an elastic ligature, which is applied sufficiently tightly to control the circulation of the blood in the part of the liver beyond its line of application. A piece of moderately stout red indiarubber tubing will be found to be the most suitable material for the purpose. The surrounding area of the peritoneal cavity is packed with large flat sponges, and care is taken not to include a coil of intestine or a piece of the omentum within the elastic ligature. The liver is now incised, the line of the incision being elliptical in shape and surrounding the tumour or cyst which it is wished to remove. The incision is deepened in such a manner that the two sides of the incision tend to meet one another in the substance of the liver beyond the deep limits of the tumour. The piece of liver and the contained tumour when removed in this manner have the form and shape of a blunt wedge, and the wound which is left after the removal of the diseased portion presents two surfaces which can easily be brought into apposition in a manner similar to that in which the two flaps of an amputation are approximated. The lines of the incisions, after the wedge-shaped portion has been removed, are shown in Figs. 45 and 47. The larger branches of the portal vein and the hepatic artery which have been divided will usually be found to lie in the region of the angle at the bottom of the incision, and there they can be picked up with fine artery forceps, and tied with fine silk. It

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[1] Bergmann, "Zur Casuistik der Leber-Chirurgie," *Arch. f. klin. Chir.*, Berlin, Bd. xlvi. s. 394.

[2] Eiselberg, "Cavernom der Leber," *Wien. klin. Wchnschr.*, 1893, No. 1.

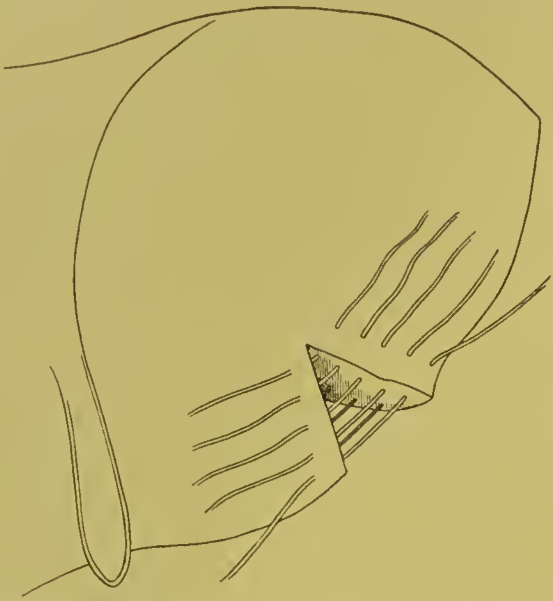

FIG. 45.—Resection of liver. Method of inserting sutures into the liver after a "wedge-shaped" portion has been removed. This diagram shows all the sutures in position before any have been tied. In this case the portion of the gland which has been resected has been from the antero-inferior margin, and the adjacent parts of the inferior and anterior surfaces of the left lobe.

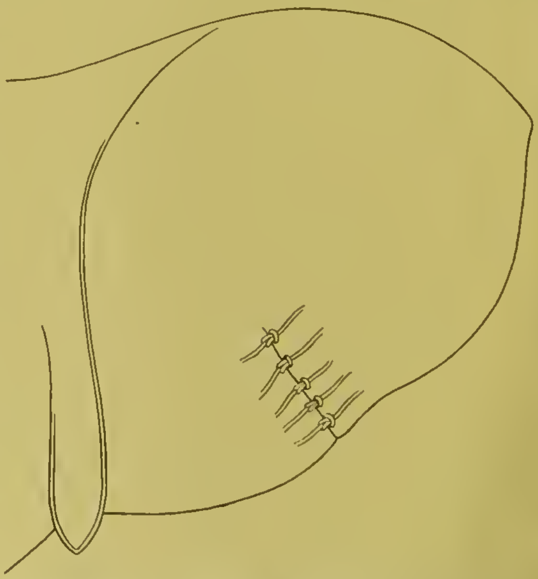

FIG. 46.—Resection of liver. Same as Fig. 45, but with all the sutures tied and the ends cut short.

will be necessary, in order to secure all the bleeding points, for the assistant who has charge of the elastic ligature to relax it slightly, so as to allow the smaller vessels to bleed, for they can then be recognised and tied. In the case of the larger vessels, however, they will be readily seen on the cut surface of the liver, and can be tied without relaxing the encircling rubber tubes. All ligatures which are applied for the arrest of hæmorrhage are cut short, and then the two flaps of the liver are brought into exact apposition, and are fixed in this position by the insertion of a row of silk sutures, which are about one-third of an inch apart. If the wound in the liver is a deep one, it may be requisite to unite its deeper parts with buried sutures, but in most cases this will not be necessary. Each suture passes through both flaps, and the method of insertion is illustrated in Figs. 45 and 47. For the introduction of the sutures a large curved needle of the shape shown in Fig. 49 is the best. The portion of the needle near

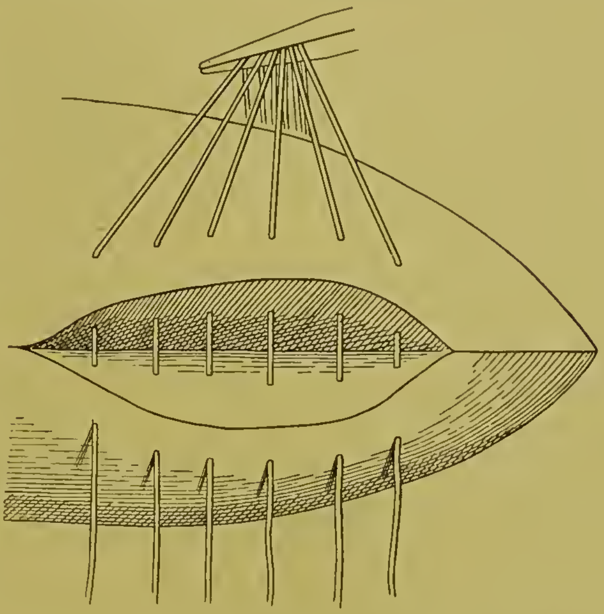

Fig. 47.—Resection of liver. Method of inserting sutures after a "wedge-shaped" portion of the liver has been resected from the surface of the gland. This illustration shows all the sutures in position before any have been tied.

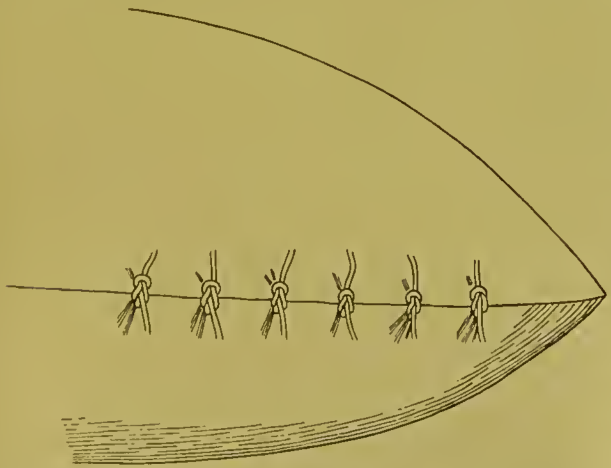

Fig. 48.—Resection of liver. Same as Fig. 47, but with all the sutures tied and the ends cut short.

the point is flattened, so that its long edge is parallel with the margin of the wound. The sutures are not so liable to cut out as when they have been introduced with an ordinary Hagedorn's needle. When the entire row of sutures has been introduced, the sutures are tied, and their ends cut short. Each suture is only tied tight enough to hold the surfaces of the liver flaps in approximation, and if too much force is used in tying them, it will be found that they cut through the edges of the flaps, an accident which must be avoided if possible. At the points of entrance and exit of the suture needle, there is in most cases rather brisk hæmorrhage at first, but this soon ceases spontaneously. When all sutures have been introduced, tied, and the ends cut short, the stump of liver is dropped back into the abdominal cavity. The exposed part of the peritoneal cavity is well sponged, so as to remove any débris, and the wound in the abdominal parietes is then closed. In those cases in which a large portion of hepatic tissue has been removed, or if there is a tendency to hæmorrhage from the incised portion of the liver, it will be advisable to pack the hepatic wound with a long strip of aseptic gauze, the end of which is allowed to remain protruding from an unclosed portion of the parietal wound. This strip of gauze or tampon is removed at the expiration of one or two days, and the wound in the abdominal wall is allowed to close, or it may be closed by the insertion of one or two points of silk suture. If on the removal of the strip of gauze there are signs of hæmorrhage or of the development of peritonitis, the wound should be again packed with a strip of gauze, so that drainage may take place, and the appearance of any further symptoms or complications recognised. It has been recommended by some surgeons that a glass or rubber drainage-tube should be passed down to the region of the wound in the liver, and left in for a few days. The employment of a long strip of absorbent aseptic gauze appears to serve all the purposes of a drainage-tube, whilst it does not possess its disadvantages.

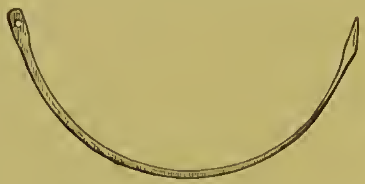
Fig. 49.—Needle for introduction of sutures into liver tissue.

*Hepatopexy or Hepatorrhaphy.*—The operation of hepatopexy or hepatorrhaphy has for its object the fixation of an abnormally movable liver to the abdominal or thoracic parietes. The entire liver, or only one portion of it, may be movable and require fixation. In most cases it has been found that it is the right lobe which requires to be anchored to the thoracic wall. In those cases in which only one lobe needs fixation the operation is called partial hepatopexy, whilst if the entire organ requires anchorage it is called complete hepatopexy. On account of the extreme difficulty which is met with in making a diagnosis of the presence of a movable liver, it will be found necessary in nearly all cases to perform an exploratory laparatomy in order to confirm the diagnosis. When the diagnosis of the condition of movable liver has been confirmed, an incision is made through the anterior abdominal wall over the movable portion of the organ, and immediately below and parallel with the costal margin. The liver is then replaced in its normal position in the upper portion of the abdomen, and a number of stout silk sutures are passed deeply into its substance, and then through the posterior aspect of the overlying portion of the anterior abdominal wall. When these sutures have been introduced they are tied, and by this means an attempt is made to fix the liver in its normal position. The ends of the sutures are cut short and the incision in the abdominal parietes closed in the usual manner. The patient is kept at rest in bed, lying in the dorsal position for several weeks, after the operation. In one case of this kind, which was operated upon by Langenbuch, the patient could walk about six weeks after the operation. In a second case, which also was operated upon by Langenbuch, a nephrorrhaphy for a floating kidney was also performed at the same time. In both these cases the liver was only partially movable. Gérard Marchant,[1] using silk sutures, has successfully fixed a liver which was completely displaced, to the costal cartilages and the anterior abdominal wall. This is the only case of complete hepatopexy which has been described in the records of surgery, according to my knowledge. The operation was completely successful.

*Hepatostomy.*—This operation has for its object the creation of a cutaneous biliary fistula, the deep extremity of which communicates with the lumen of one or more of the intra-hepatic bile ducts. It was performed by Knowsley Thornton[2] on a patient who suffered from a large accumulation of biliary calculi within the intra-hepatic bile ducts. It is carried out through an abdominal incision made over that portion of the liver in which the dilated and calculus-containing bile ducts are situated. When the surface of the liver is exposed, an incision is made through the hepatic tissue, and deepened until the dilated bile duct is opened. The contained calculi are removed, and then the margins of the wound in the liver and the dilated intra-hepatic bile ducts are united to those of the incision in the abdominal parietes, the remaining portion of the external wound being closed in the usual manner. During the performance of the operation the peritoneal cavity is packed with flat sponges, to prevent the possibility of any septic contamination, owing to the entrance of any of the material which is removed from the interior of the dilated bile ducts. Before the peritoneal cavity is closed it is advisable to examine the course of the extra-hepatic bile ducts, to ascertain if calculi are arrested in any portion of them. If any are found they should be removed, according to the methods which have already been discussed. The patient who was operated upon by Thornton recovered after more than four hundred calculi had been extracted.

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[1] Gérard Marchant, "Hepatopexie," *Bull. Acad. de med.*, Paris, Aug. 11, 1891.

[2] Thornton, *Brit. Med. Journ.*, London, 1887.

Baudouin[1] has recently described this operation under the name of "Cholangiostomie."

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[1] Baudouin, *Progrès méd.*, Paris, April 25, 1896.

# CHAPTER XXV.

## OPERATIONS UPON THE GALL BLADDER.

*Tapping and Aspiration.*—The operation of tapping or aspiration of the gall bladder has been performed both as a diagnostic measure and as a form of treatment. It can be done either with a trocar and cannula, or with the needle of some form of aspirator or exploring syringe. In most cases it will be found convenient and advisable to use the form of aspirator which is known as Potain's. In aspirating a swelling which is situated in the hepatic area or connected with the liver, the most prominent portion of the tumour is selected, and the skin over it rendered as aseptic as possible, by washing first with soap and water, then with ether, and finally with a solution of corrosive sublimate (1–500). The needle of the aspirator is pushed inwards through the abdominal wall until it enters the interior of the swelling. Care must be taken not to force the point of the needle beyond the swelling which is the subject of examination, otherwise important anatomical structures in the immediate neighbourhood of the gall bladder and liver may be injured. When the point of the needle has been felt to enter the interior of the tumour or swelling, it is connected with the pump of the aspirator, and a sufficient quantity of the contents are withdrawn to allow of an examination of the substance or fluid being made. In those cases in which aspiration is carried out as a form of treatment, the amount of fluid which is to be withdrawn depends upon the object of the operation and the pathological condition for which it is done. Thus, in cases of hydatid disease of the liver, it may be desired to withdraw only a few drachms of the fluid contents, or it may be wished to empty the cystic swelling completely. After this operation has been performed for the purposes of diagnosis, the fluid contents of the enlarged gall bladder or other form of tumour which is being examined, are very liable to leak and escape through the tract of the puncture into the peritoneal cavity, and give rise to acute peritonitis.

In those cases in which the gall bladder is the seat of an inflammatory or septic process, septic peritonitis is very liable to develop after the aspiration has been carried out. Many cases have been recorded in which fatal results have followed a simple exploratory puncture with the needle of an aspirator or a small trocar. On account of the frequency of fatal results from this method of procedure, it is very undesirable that aspiration of a tumour or swelling of the gall bladder should become a routine method of diagnosis in obscure cases; and it is recommended that it should only be performed exceptionally, and in those cases in which permission is given to perform any further operation which may prove to be requisite after the examination has been made. When it is impossible to establish a diagnosis without examining the contents of the tumour, it is safer for the patient to submit to an exploratory laparotomy, so that the exact nature of the swelling can be made out, and if it is necessary to perform an operation for the relief of the abnormal condition, this can be carried out through the same incision in the abdominal wall, the wound being lengthened if requisite. The trocar and cannula, or the aspirator, is often found to be of considerable use in drawing off the contents of a distended gall bladder or of a cyst, after an incision has been made through the abdominal wall, and the surface of the swelling has been exposed, since evacuation of the contents facilitates the free exposure of the gall bladder, and enables the surgeon to draw the distended viscus into the wound.

*Sounding for gall stones.*—A method of examination of patients who are supposed to be the subjects of gall stones, which has been advocated by Harley and other observers, has been called "sounding for gall stones." This procedure is carried out by introducing a long needle through the anterior abdominal wall in the immediate neighbourhood of the swelling supposed to be a gall bladder or bile duct containing a calculus, and feeling with the point of the instrument for any hard solid body which may be a gall stone. Instead of plunging the sounding needle directly through the abdominal wall, a trocar and cannula may first be pushed into the swelling. After withdrawal of the trocar, a needle is passed through the cannula, and the area of the swelling is then examined. This appears to me to be a most dangerous method of examination, since the results which may follow its employment are very uncertain, and injuries of the liver, gall bladder, great blood vessels, and other adjacent viscera, may very easily and unknowingly be inflicted, and give rise to a fatal termination. A fatal result followed in one case which was examined in this manner by Harley. In those cases in which it is not an easy matter to make an exact diagnosis, it is far safer and much more satisfactory to make a small incision through the abdominal wall over the prominent portion of the swelling, and to examine with the fingers the relations and connections of the abnormal swelling, and its position with regard to the different parts of the biliary system. Even if no further operative measures can be employed for the alleviation of the disease, no ill results are likely to follow an examination of this kind, if it is carried out under strict aseptic precautions.

*Cholecystotomy.*—By this term we understand the performance of an operation which involves making an incision in the wall of the gall bladder through a wound in the overlying portion of the abdominal wall, and fixing the margins of the incision in the gall bladder to the lips of the parietal wound. This operation is apparently a comparatively modern one, and Bobbs of Indianopolis appeared to have performed it successfully for the first time in 1867, whilst Marion Sims in 1878 described in detail the method of performance of the operation. There are several varieties of this operation, the distinctions between them depending upon whether the operation is performed in one stage or two, and whether or not the gall bladder is fixed to the margins of the incision in the abdominal wall, before its interior is examined through an incision in its walls; and also upon the method of after-treatment, when the cavity of the viscus has been examined and any stones which may have been present removed. The form of operation which will be found of the most use, and applicable in the majority of cases of gall stones, is the following:—

*Operation.*—The patient is placed in the dorsal position, and the abdominal walls are rendered thoroughly aseptic in the usual manner. An incision is then made through the abdominal parietes over the most prominent portion of the tumour. In most cases it will be found convenient to make this incision in a vertical direction, commencing above immediately below the costal margin, and, if possible, in the right linea semilunaris or in the linea alba. In those cases of supposed gall stones in which no tumour can be felt it is usually advisable to make the incision in the right linea semilunaris, commencing above at the ninth costal cartilage. The incision in the abdominal parietes is at first made about three inches in length, but it can be made longer if the nature of the case requires it. The incision is deepened until the peritoneum has been divided for the entire length of the wound, all bleeding points in the tissues of the abdominal wall being ligatured before the peritoneal cavity is opened. The gall bladder is sought for and brought into the wound, if it does not at once protrude. In many cases of gall stones it will be found to have acquired fibrous adhesions to the adjacent viscera, and in order to bring it to the surface these adhesions may require to be separated and ligatured. If the gall bladder is distended, and fills up that portion of the abdomen in the region of the wound, it may be difficult at first to ascertain the exact nature of the conditions which are presented. In these cases it is better to pack the region of the distended gall bladder with flat sponges, in order to protect the intestines and other viscera from injury or contamination, and then to evacuate the fluid contents of the swelling with a trocar and cannula or an aspirator. Care must be taken, especially in those cases in which the gall bladder is the seat of an inflammatory condition, not to allow the peritoneum to become contaminated with the material which is removed from the cavity of the inflamed viscus. When the gall bladder has been emptied in this manner, the walls become flaccid, and it can readily be drawn into the parietal wound. A vertical incision, about one inch in length, is then made in the fundus of the gall bladder, and its

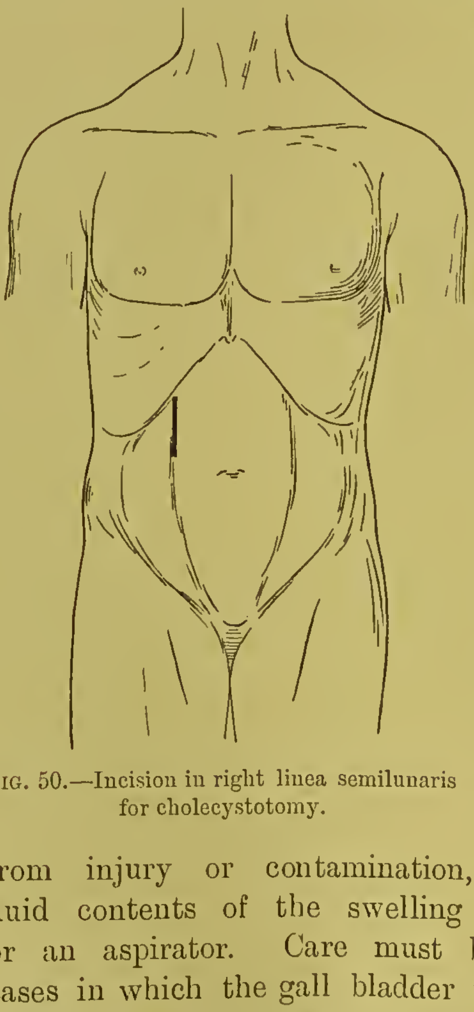

FIG. 50.—Incision in right linea semilunaris for cholecystotomy.

margins are held apart with forceps. As the wall of the gall bladder is divided, a strong silk ligature is passed through each margin of the wound, and the ends are given to assistants to hold. These ligatures serve to hold the gall bladder well up in the wound, and to approximate its walls to the margins of the incision in the abdominal parietes, and so avoid or minimise the possibility of the entrance of extraneous matter into the peritoneal cavity. The cavity of the organ is now thoroughly examined with the finger, and all calculi are removed either with the finger or with long and fine lithotomy forceps. Sometimes a gall stone is found embedded in or grasped by the neck of the gall bladder and the commencement of the cystic duct,

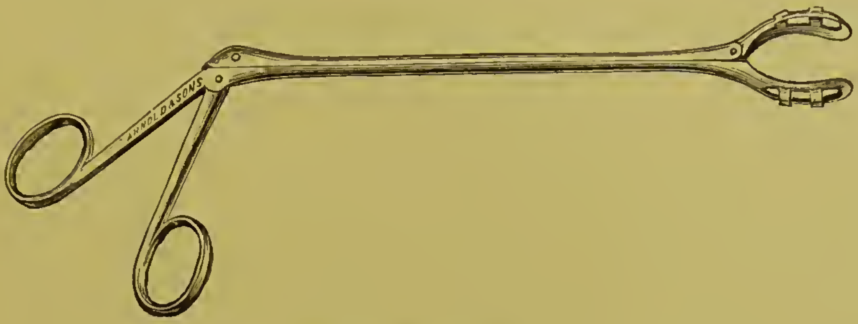

Fig. 51.—Cholecystotomy forceps (Tait's pattern).

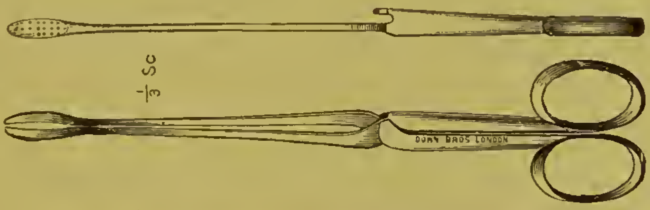

Fig. 52.—Cholecystotomy forceps (Anderson's pattern).

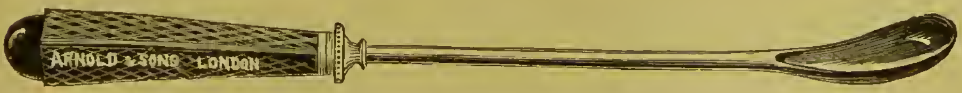

Fig. 53.—Cholecystotomy. Scoop for removing gall stones from gall bladder or cystic duct (Tait's pattern).

in which case it is seized with the forceps and carefully extracted. If it is firmly fixed, its removal may be facilitated and rendered possible by passing the finger into the peritoneal cavity in the region of the cystic duct, and manipulating the stone from the external aspect of the neck of the gall bladder and the cystic duct. By the adoption of this method of manipulation, calculi in this position can, in nearly every case, be dislodged and removed. After the gall bladder has been evacuated in this manner, its interior is irrigated with a dilute antiseptic solution, and is then packed temporarily with a sponge, to which a silk thread is attached. The sponges or pads of gauze which were used to protect the peritoneum are now removed, and a complete and systematic examination of the course of the extra-hepatic bile ducts made, in order to ascertain if there are any calculi or other forms of obstruction present. The course of the cystic duct should be examined first, and afterwards that of the common bile duct, both as it passes through the gastro-hepatic omentum, and also as it lies behind the first part of the duodenum and in relation with the head of the pancreas. In order to carry out this examination, it is necessary to have the coils of intestine well retracted towards the left by the fingers of an assistant. If any pathological condition, such as the impaction of a calculus, is found in the cystic, hepatic, or common bile ducts, it is dealt with according to the methods which are described later when the operations upon these ducts are under consideration. These measures having been carried out, if it is decided that they are requisite, the peritoneum is rendered free from all blood and other foreign matter, and then the margins of the incision in the gall bladder are joined to those of the parietal wound by the insertion of a number of interrupted silk sutures, which are introduced at intervals of one-third of an inch. Each suture passes through the wall of the gall bladder and through the abdominal wall, the entire row being introduced before any are tied. The uppermost and the lowermost of the sutures which pass through the wall of the gall bladder are made to pass from one side of the wound in the parietes to the other, and to pick up the muscular and serous coats of the gall bladder just beyond the angles of the incision. By this means the angles of the wound in the gall bladder are lifted well into the abdominal wound, and any escape of fluid at these spots is avoided. The portion of the wound in the abdominal wall which lies above and below the opening in the gall bladder is carefully closed with silk sutures in the ordinary manner, and all possibility of infection of the peritoneum avoided, as far as possible. When the gall bladder has been fixed to the abdominal wall, and the remainder of the parietal incision closed, a guarded red rubber drainage-tube is passed into its cavity so as to allow of free drainage, and then aseptic absorbent dressings are applied. In some cases the anterior surface of the fundus of the distended gall bladder is found to be adherent to the posterior aspect of the anterior abdominal wall, and when this condition is met with an incision can at once be made into the cavity of the gall bladder, and its contents evacuated. When this has been done, the interior is washed out; the after-treatment is similar to that mentioned above. If the operation has been successful as regards the removal of all causes of obstruction, the biliary fistula which results from the fixation of the aperture in the gall bladder to the abdominal wall will usually close within a few weeks from the time of the operation; but if it does not close spontaneously, it is necessary to deal with the fistula according to the methods which are considered in Chapter XXII. This is the best variety of the operation of cholecystotomy, since it allows the surgeon to make a complete examination of the entire course of the biliary ducts; and on this account it is recommended. The operation itself has been called "cholecystotomy with primary incision of the gall bladder and secondary fixation to the abdominal wall," in contradistinction to another variety in which the gall bladder is first fixed to the margins of the abdominal wound by sutures, and its wall subsequently incised, its interior examined, and its contents evacuated. The advantage of this operation is that the peritoneum is less likely to become contaminated, but this is much outweighed by the disadvantage of not being able to examine the course of the bile ducts; and, moreover, in the first-described operation, if care is taken to protect the peritoneum, no contamination need result. On this account the performance of the operation with primary incision of the gall bladder and secondary fixation to the abdominal wall is strongly recommended, in all cases in which it is necessary to examine the interior of the gall bladder and to remove pathological collections from its cavity. When the operation is performed in two stages, it has been called "cholecystotomy *à deux temps.*" In the first stage the abdominal wall is incised and the fundus of the gall bladder is fixed in the incision and left for three to five days, when an incision is made through the exposed area, the interior of the organ examined, and any purulent collections or calculi removed. This form of operation is not recommended, since it does not allow the operator to make an examination of those parts of the bile ducts which lie beyond the gall bladder or the commencement of the cystic duct.

The performance of the operation of cholecystotomy is indicated in the following clinical and pathological conditions:—

(*a*) In cases of empyema of the gall bladder. In this condition the gall bladder is filled with purulent fluid, which may contain a number of calculi. Empyema of the gall bladder may occur in connection with gall stones, inflammatory affections of the bile ducts owing to extension from the duodenum, the passage of an ascaris into the gall bladder, in typhoid fever, in tubercular disease of the gall bladder, and in connection with primary new growths which involve the mucous membrane.

(*b*) In cases in which it is desirable to establish a temporary biliary fistula.

(*c*) In cases of distension of the gall bladder with mucus, owing to the impaction of a calculus in the cystic duct.

(*d*) In all cases of gall stones which are situated within the gall bladder and are associated with an inflammatory condition of the walls of the viscus.

(*e*) In cases of rupture of the gall bladder, in which the rupture is large and is situated in the region of the fundus.

(*f*) In those cases of gall stones in which the calculus is impacted in the cystic duct, and it appears probable that it can be extracted through the gall bladder, or in which it can be manipulated backwards into the cavity of this organ.

Terrier of Paris has recently advocated the performance of cholecystotomy in certain inflammatory affections of the bile ducts, and also in cases of hypertrophic cirrhosis of the liver. In the former class of cases he appears to have met with a fair amount of success, but in the latter, there is not, as yet, sufficient evidence to show that the performance of the operation has been of permanent value.

According to the statistics of Courvoisier[1] and Martig,[2] the following results have been met with in 161 cases of ordinary cholecystotomy; that is to say, cases in which the operation has been performed at one sitting, and the gall bladder has been opened before it has been sutured to the margins of the parietal incision. In forty-six cases the result was a complete cure, in forty-eight it was doubtful, in thirty-five a fistula remained (in four cases the discharge was pus and in the remainder bile), and

[1] Courvoisier, *op. cit.*

[2] Martig, "Beitr. z. Chirurgie d. Gallenwege," Basel, 1893.

in thirty-two cases a fatal termination followed, in fifteen of which death was said to be directly due to the operation and in seventeen indirectly. The results of cholecystotomy in which the gall bladder was sutured to the abdominal wall before being opened, according to the same authors, are as follows:—Out of thirty cases eleven resulted in a complete cure, two remained uncured, four had fistulæ left, and thirteen died (six directly from the operation and seven from causes not directly connected with the operation). In sixty-six cases, in which the operation was performed in two stages, forty-two were definitely cured, three were not benefited, one was improved, four had a permanent biliary fistula, seven had a mucous fistula, in one the result was doubtful, and eight died (six directly from the operation and two from causes not immediately dependent upon the operation) The percentage of complete cures appears to have been greatest when the operation was performed in two stages, but this is probably due to the fact that the cases in which this method can be adopted are much more favourable than those in which the procedure is carried out at one sitting. Riedel of Jena,[1] has obtained the best results from the operation in two stages, and strongly recommends its adoption. Hans Kehr[2] has recently collected and published all cases of cholelithiasis which had been operated upon by him during the years 1890-1895. In ninety-six cases he performed cholecystotomy in one stage, and in three cases in two stages, with no fatal result.

*Cholecystendysis or Ideal Cholecystotomy.*—In the performance of this operation the incision in the abdominal parietes is similar to that which is made use of in cholecystotomy. When the peritoneal cavity has been opened, and the gall bladder exposed, it is drawn into the wound and a small incision made through its wall in the region of the fundus. This incision must be large enough to allow of the easy removal of the contained calculus. In those cases in which the organ has been perforated by some traumatic agent, or the wall has been ruptured owing to external violence or by ulceration, the portion of the gall bladder in which the aperture is situated is drawn into the wound and the injured area is fully exposed. The margins of the rupture are then thoroughly cleansed and united according to the method of suture which is described later. In cases of calculi the gall bladder is completely evacuated by removing its contents through the opening which has been made. When the calculi are large, it is better to make an attempt to break them up into several fragments, by crushing with a form of straight lithotrite or forceps, before removing them, in order to avoid the necessity of enlarging the aperture in the wall of the organ. Care must be taken, when removing calculi in this manner, not to lacerate the walls of the gall bladder, or damage them by tearing the mucous membrane in the region of the incision. When the wall of the gall bladder is ulcerated or perforated by gall stones, it is advisable to trim up the edges of the rupture with a pair of scissors before sutures are inserted. Under these circumstances, however, this form of operation should be only exceptionally made use of. The margins of the incision or rupture are united by the introduction of two or three tiers of fine sutures. The first tier unites the mucous membrane alone, and for this purpose a continuous suture of fine silk or aseptic catgut should be used; the second tier approximates, if possible, the edges of the muscular coat, and should consist of interrupted sutures of fine silk, inserted about one-fourth or one-third of an inch apart; whilst the third or most superficial tier unites the serous or peritoneal coat, and consists of fine silk sutures, introduced after the method of Lembert. The ends of all the sutures are cut short, and then the area of the wound in the gall bladder and the surrounding parts are well sponged and cleaned, and the gall bladder dropped back into the peritoneal cavity. The region of the operation is irrigated with sterilised water, if there has been any escape (into the peritoneum) of blood, fluid from the gall bladder, or calculi, and then the external wound in the abdominal parietes is closed in the usual manner. Some surgeons advise that a small part of the abdominal wound should be left open, through which a small drainage-tube or a strip of aseptic gauze should be inserted, and the lower extremity passed into the region of the rupture or incision in the gall bladder, so that if any escape or leakage of bile occurs it may at once be detected.

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[1] Riedel, *op. cit.*

[2] Kehr, "Die Chirurgische Behandlung der Gallensteinkrankheit," 1896.

The performance of the operation of cholecystendysis, or ideal cholecystotomy, appears to be indicated in the following conditions, namely:—

1. In those cases in which there is a small wound in the gall bladder in the region of the fundus, which has been caused

by a sharp instrument, and in which no signs of peritonitis have developed;

2. When the gall bladder contains one or more small calculi and the walls of the organ are in a perfectly healthy condition;

3. In cases of rupture of the gall bladder from external violence, when the aperture is situated in the neighbourhood of the fundus, is small, and there is no accompanying peritonitis.

Cholecystendysis is contraindicated—(*a*) in all cases of large calculi in the gall bladder; (*b*) in every case in which inflammatory conditions involve the gall bladder or the structures in its immediate neighbourhood; (*c*) in nearly all cases of perforation of the walls of the gall bladder as the result of ulceration; (*d*) in cases of rupture and perforation of the gall bladder when the injuries are situated in the region of the neck of the organ, and cannot easily be manipulated; (*e*) in all cases in which there is a simultaneous obstruction in the common bile duct.

Zielewicz recommends that in all cases in which cholecystendysis has been performed, the cystic duct should be closed by the application of an absorbable ligature before the operation is completed, so as to prevent for a time the passage of bile into the gall bladder. If a catgut ligature be employed for this purpose, it is possible that, in a short time after its introduction, it will be absorbed, and then bile will again pass into the gall bladder; and if this can be relied upon, time will be allowed for the wound in the wall of the gall bladder to become closed by the exudation of lymph and union of the divided surfaces, before the organ is dilated with bile. This modification does not appear to have been made use of in a sufficient number of cases to enable an opinion upon its value to be formed. If a ligature is applied in this manner, care must be taken not to tie it too tightly, otherwise ulceration of the mucous membrane of the cystic duct may be induced, and be followed later by the development of a fibrous stricture.

*Czerny's modification of cholecystendysis.*—Czerny has advised that in those cases in which it is unnecessary to establish a fistulous communication with the surface, the margins of the wound in the gall bladder should be closed and fixed to the parietal peritoneum in the abdominal wound, and after this has been accomplished the margins of the parietal incision are approximated in the usual manner. He says that when this has been done the fluid or exudation from the gall bladder will pass out through the external wound, and hence become apparent. It is probable, however, that if the external wound is completely closed in this manner, the superficial layers of the abdominal wound will unite quickly and not allow the passage of any fluid, and on this account the contents of the gall bladder may pass into the peritoneal cavity and be a source of danger. It is probable, however, that this method of operation is somewhat safer than ordinary cholecystendysis.

Martig[1] has collected the statistics of fifty-seven cases of cholecystendysis (eighteen from Courvoisier), and of these forty-three recovered; in four there was a recurrence, in one a fistula remained, three died directly from the operation, and six from causes only indirectly connected with the operation. It appears from these figures that the operation has resulted in cure in about 84 per cent. of cases.

Hans Kehr[2] has recently reported two successful cases of cholecystendysis; in one, a large calculus was removed, and in the other Loreta's divulsion of the pylorus was also performed.

*Cholecystectomy.*—The operation which comprises a removal of the gall bladder is known as cholecystectomy. It was first proposed and performed by Langenbuch.[3] The operation is performed in the following manner:—An incision 3 to 5 in. long is made in the right linea semilunaris, commencing above at the costal margin and extending through the abdominal parietes until the peritoneal cavity has been opened. The gall bladder is drawn into the wound, and the adjacent part of the peritoneum is packed with sponges, so as to keep the intestines free from injury, and to avoid the entrance of blood or any of the contents of the gall bladder. The gall bladder is evacuated either by incision or aspiration, if it is distended with fluid. Two parallel incisions are next made through the peritoneum, one on each side of the gall bladder as it lies in its fossa upon the inferior aspect of the liver, which divide the peritoneum, and another incision is made which joins the anterior extremities of the two first along the antero-inferior border of the liver. The gall bladder can now be easily separated from its connection with the inferior surface of the liver by means of the fingers, or the handle of the scalpel, or a blunt director. This separation is carried backwards until the neck of the organ and the cystic duct are reached, when it will be seen that the gall bladder only remains attached by the duct. The cystic duct is surrounded with two ligatures about half an inch apart, which are tied, and then the intervening portion is divided with the knife, and the gall bladder removed. In order to facilitate this part of the operation, it is advisable to direct an assistant to hook the antero-inferior border of the liver upwards and forwards with his bent fingers or a large retractor. The hæmorrhage which follows the separation of the gall bladder from the liver varies in amount; in some cases it is almost absent, whilst in others it is very profuse, and the actual cautery may have to be called into requisition in order to arrest it; but usually hot-sponge pressure, and the application of a few fine silk ligatures to any definite bleeding points, prove sufficient. After the gall bladder has been removed, and the resulting hæmorrhage arrested, the margins of the divided peritoneum upon the inferior aspect of the liver are brought together and fixed in apposition with sutures. The free end of the cystic duct may be cauterised with the needle of a Paquelin's cautery, and, if possible, the mucous lining of the ligatured portion of the duct should be removed, either by scraping with a sharp spoon or with the cautery. The sponges are now removed from the peritoneum, and the region of the operation irrigated so as to remove all traces of blood and other débris. The wound in the parietes is then closed. In those cases in which all the hæmorrhage has been arrested and there are no signs of recurrence, the entire wound is closed, but when there has been much bleeding during the operation, and oozing of blood from the area of the gall bladder cannot be completely arrested, it is advisable to pack the part with a long strip of aseptic gauze, the end of which is brought out through an angle of the parietal wound, which is left open for the purpose. This can be removed in one or two days' time, and if there are signs of the recurrence of hæmorrhage at the time of removal another strip can be inserted.

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[1] Martig, *op. cit.*

[2] Kehr, *op. cit.*

[3] Langenbuch, *op. cit.*

Calot[1] has made statistics comprising records of seventy-eight cases; of these 17·9 per cent. terminated fatally, but in seven he considers that death was due to causes independent of the operation upon the gall bladder; hence he places the mortality of cases in cholecystectomy at 8·9 per cent. Sprengel[2] has recorded a case in which the gall bladder was removed, and at the same time the common bile duct was found to be dilated and blocked with a calculus, and on this account a choledocho-duodenostomy was performed. The patient recovered. Broca recommends that the stump of the cystic duct should be drained after the gall bladder has been removed; he has performed the operation successfully in three cases. Mermann [1] has recently published five cases, of which four recovered and one died on account of hæmorrhage from the area of the operation. The patient was jaundiced, and the hæmorrhage was said to be "cholæmic" in character. Beckmann has recorded a fatal case, in which the patient died on the fourth day after the operation, from peritonitis and bleeding from the liver. In this patient a calculus was discovered at the post-mortem to be impacted in the common duct. In one of Terrier's cases, in which the gall bladder was removed on account of calculi and ulceration of its walls, a biliary fistula developed on the eleventh day after the operation, and from this, at intervals, several small calculi were discharged, the fistula closing on the fiftieth day. These cases of Beckmann and Terrier emphasise the importance of making a complete examination of the entire course of the biliary ducts at the time of the operation, so as to exclude as far as can be done the possibility of leaving a calculus undetected in the common bile duct or in the hepatic ducts. When the calculi are intra-hepatic, it is not possible to detect them under ordinary conditions.

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[1] Calot, "De la Cholecystectomie." Thèse de Paris, 1891.

[2] Sprengel, *Deutsche med. Wchnschr.*, Leipzig, 1891, s. 1061.

Before removal of the gall bladder on account of carcinoma, a careful examination of the adjacent part of the liver, the lymphatic glands in the region of the portal fissure, and the course of the bile ducts, should be made, in order to ascertain if any secondary growths are present, or if the ducts are affected by a direct extension of the disease. Hans Kehr has recorded a case in which a biliary fistula developed after removal of the gall bladder, and on performing a second operation the common bile duct was found to be involved in a carcinomatous lymphatic gland the size of a walnut. No radical measure was possible, and the patient died ten days after the second operation. Kehr has removed the gall bladder nineteen times, with only one fatal result.

The performance of the operation of cholecystectomy is indicated in the following pathological conditions, viz.:—

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[1] Mermann, "Beitr. z. Chir. der Gallenwege," *Beitr. z. klin. Chir.*, Tübingen Bd. xiii. s. 319-389.

(*a*) In those cases of carcinoma of the gall bladder in which the growth is strictly limited and secondary deposits have not developed in other viscera.

(*b*) In cases of ulceration of the gall bladder in which several perforations of its walls have occurred, or in which the walls have become gangrenous.

(*c*) In some cases of contracted gall bladder which are dependent upon old chronic inflammation.

(*d*) In cases of rupture of the gall bladder, owing to external violence, in which the ruptures are extensive, or situated in the region of the neck, and in perforating wounds which are very large or near the neck of the organ.

(*e*) In all cases of distension of the gall bladder with pus or mucus (empyema or hydrops), which are associated with complete closure of the cystic duct by chronic inflammatory processes.

Removal of the gall bladder must never be performed when the common bile duct is permanently closed or obstructed, either by a new growth or a fibrous tissue stricture, or when the organ has acquired very extensive adhesions to the adjacent viscera. Out of eighty-seven cases of cholecystectomy which have been collected by Martig, seventy-two recovered and fifteen died, twelve directly from the operation, and three from indirect causes.

*Cholecystenterostomy.*—In the performance of this operation a fistulous canal is established between the cavity of the gall bladder and the lumen of some portion of the alimentary canal, usually the duodenum or some other part of the small intestine, and only in rare cases the transverse colon. A considerable number of varieties of this operation have been described and adopted by different surgeons, and they can be classified according to the number of stages into which the procedure has been divided. There are operations in one stage, in two stages, and in three stages.

*Operations in one stage.*—(1) By sutures: a parietal incision is made in the upper part of the right linea semilunaris, 3 to 4 in. long, by which the peritoneal cavity is opened. The gall bladder, which is usually distended in cases requiring this operation, is sought for and brought into the wound, the surrounding part of the peritoneum packed with sponges, and then the distended viscus punctured with a trocar and cannula, by which means its fluid contents are evacuated. An incision is made in the wall of the gall bladder passing through the point of entrance of the trocar, through which the entire contents of the organ are removed, its interior well irrigated with a dilute aseptic solution, and its cavity temporarily packed with a small sponge, and then the viscus is replaced within the abdomen. A loop of the small intestine, preferably the duodenum or the upper portion of the jejunum, in most cases the latter, is brought out through the abdominal wound, and its interior emptied of its contents by forcing them onwards with the fingers. At each extremity of the loop a strong silk ligature is passed, with an aneurism needle, through the mesentery near its attachment to the bowel. These silk ligatures are given to assistants to hold, and they serve first to occlude the lumen of the gut after it has been emptied of its contents, and, secondly, to hold the loop steady in the parietal wound. An incision similar in length to that which has been made in the gall bladder, from $\frac{1}{2}$ to $\frac{3}{4}$ in., is now made on the convexity of the intestinal loop, opposite the attachment of the mesentery, and parallel with the long axis of the bowel. The gall bladder is then brought into the abdominal wound again, the sponge is removed from its interior, and the incision in the bowel is approximated to that in the gall bladder, their margins being fixed in apposition by the insertion of a double row of interrupted sutures of fine silk. The first row of sutures aims at uniting the mucous membrane at the lips of the apertures closely together. The second row of sutures unites the serous and muscular coats of the gall bladder and intestine. When all the sutures have been introduced, tied, and the ends cut short, the structures which have been exposed during the operation, and the adjacent part of the peritoneum, are thoroughly cleansed and freed from blood and débris by irrigation with sterilised water, or a dilute antiseptic solution. The silk sutures are then removed from the mesentery, the apertures through which they passed being closed with fine sutures, if it is thought advisable. The gall bladder and the intestine are replaced within the abdomen, and the parietal incision closed with sutures in the usual manner.

(2) By the use of "Murphy's button." A small variety of anastomosis button is made use of in this operation, which is performed in the following manner :—An incision is made from the edge of the ribs, 2 in. to the right of, and parallel to, the median line, extending downwards for 3 in. The gall bladder and the duodenum are drawn into the wound ; a needle,

threaded with 15 in. of silk, is inserted into the duodenum, directly opposite the attachment of the mesentery, and at a point near the head of the pancreas; a stitch is taken through the entire bowel, one-third of the length of the incision to be made; the needle is again inserted one-third the length of the incision from its outlet, in a line with the first, and embracing the same amount of tissue as the first. A loop 3 in. long is held here, and the needle is inserted in a similar manner, making two stitches parallel to the first in the reverse direction, and one-fourth of an inch from it, coming out at a point near the insertion of the needle. This forms a running thread, which, when tightened, draws the incised edge of the bowel within the cup of the button. A similar running thread is inserted in the gall bladder. An incision is now made in the intestine, which is two-thirds of the diameter of the button to be used, care being taken to avoid cutting the running thread when making the incision; the male half of the "button" is slipped in, the running thread tied firmly around the central cylinder, and then the button is given to an assistant to hold with forceps, so as to prevent it slipping into the cavity of the bowel An incision is now made in the gall bladder, the same length as the one in the intestine, between the two rows of suture. The gall stones and fluid contents of the gall bladder are removed; the female half of the "button" inserted, and the running thread tied. The forceps are then removed, the two halves of the "button" are held between the fingers and slowly pressed together. A sufficient degree of pressure must be used to bring the serous surfaces of the gall bladder and intestine firmly in apposition and compress the tissues. The elastic pressure of the spring cup of the "button" produces a pressure atrophy of the tissues embraced by it, and leaves an opening which is larger than the "button." When the latter is liberated, it passes on through the bowel,

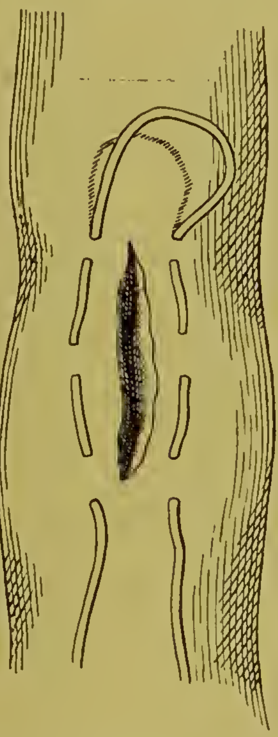

Fig 54.—Method of inserting "purse-string suture" into intestine in the operation of cholecystenterostomy.

and is voided per anum from eight to fourteen days after the operation. The advantages which have been claimed for this method of operation, and the use of "anastomosis buttons," are the following:—(*a*) The use of sutures is dispensed with; (*b*) invagination is not required; (*c*) non-apposition is impossible, and there is no danger of sloughing through of discs, or too rapid digestion of catgut; (*d*) there are no difficulties of technique; and (*e*) prolonged exposure of the abdominal contents and protracted anæsthesia are avoided. There appears to be no doubt that, by the use of this contrivance, the margins of the apertures can easily be brought into exact apposition, and retained in that position until the "button" becomes separated; but it seems possible that in certain cases, where the walls of the viscera are thin, the "button" will separate before firm adhesions have been formed; and on this account I think that, after the "button" has been inserted, it is advisable to further fix the gall bladder and the duodenum by inserting a row of interrupted sutures of fine silk immediately outside the edge of the "button." In a case of cholecystenterostomy which I operated upon by this method, without using sutures, the button separated on the fifth day, a

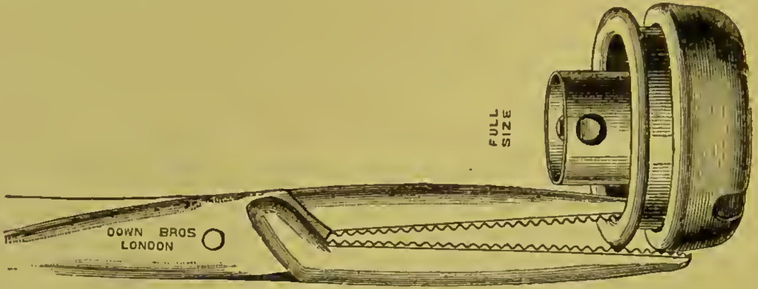

Fig. 55.—Cholecystenterostomy. Method of holding male half of anastomosis button for insertion.

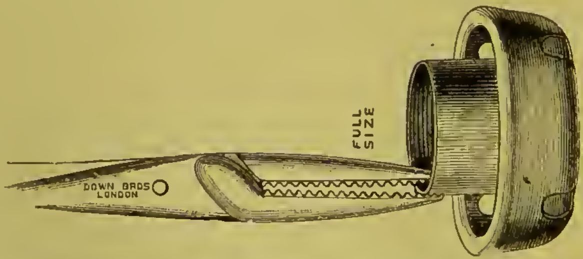

Fig. 56.—Cholecystenterostomy. Method of holding female portion of anastomosis button for insertion.

considerable amount of hæmorrhage followed, the line of union of the gall bladder and the duodenum gave way, and the contents of the bowel passed into the peritoneal cavity, causing fatal peritonitis.

*Operations in two stages.*—Winiwarter of Luttich has been the chief supporter of this form of cholecystenterostomy. The early stages of the operation are similar to those of the operation in one stage. After the abdominal cavity has been opened, the gall bladder and a loop of small intestine are drawn into the wound, and an area upon the convex surface of the gall bladder, about one inch long and half an inch wide, is selected and approximated to a similar area upon the convexity of the selected loop of small intestine; these two areas are fixed in apposition by a number of sutures introduced through the serous and muscular coats of both viscera, at the margins of the selected areas. These are tied, and the loop of bowel is fixed into the bottom of the abdominal wound by means of a few silk sutures. The external wound is packed with an aseptic dressing, and four or six days afterwards the intestinal loop is again drawn out into the parietal wound, and a vertical

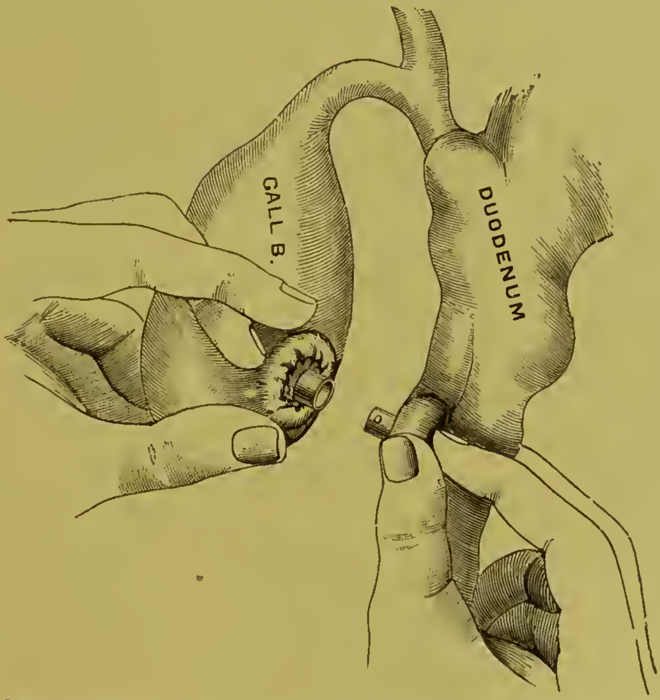

Fig. 57.—Cholecystenterostomy. Gall bladder and duodenum, showing two halves of anastomosis button, introduced with the "purse-string" sutures tied, and ready for fixing together.

incision made into its convexity a short distance below the area where the gall bladder and intestine have been fixed in apposition. With the knife of a thermocautery, the cavities of the gall bladder and intestine are made to communicate by destroying their walls where they lie in contact. The mucous membrane of the gall bladder is then fixed to that of the intestine at the margins of the aperture by the insertion of a few fine silk sutures; and, finally, the incision in the intestine lower down is closed with sutures. The intestine and gall bladder are dropped back into the peritoneal cavity, the parts in the region of the operation thoroughly washed and irrigated, and then the wound in the abdominal parietes closed in the usual manner.

*Operations in three stages.*—In the first stage the abdomen is opened by an incision in the right linea semilunaris, and an oval area upon the lower surface of the gall bladder approximated and fixed to a loop of the small intestine, in a manner similar to that described in the operation "in two stages." When this has been done, the gall bladder is drawn into the parietal wound, an incision made into it, and its contents evacuated. The margins of the incision in the gall bladder are united to those of the parietal incision, and the remainder of the abdominal wound is closed. By this means a biliary fistula is established. Aseptic dressings are applied and changed, as occasion demands. At the expiration of eight or ten days the second stage is carried out. The partition between the gall bladder and the adherent loop of intestine is divided with a scalpel, care being taken not to divide the tissues beyond the adherent area. This procedure may be rendered easy by introducing during the first stage of the operation two silk ligatures, the ends of which are left long, through the mucous membrane of the gall bladder, one at the upper limit and the other at the lower limit of the approximated area, so that, when the division of the partition is made, the incision may extend through the tissue between the points of attachment of these two silk loops. After the partition has been divided, and a communication between the cavity of the gall bladder and the lumen of the gut established, the mucous membrane of the gall bladder is united to that of the intestine along the margins of the fistulous aperture. This completes the second stage of the operation. At the expiration of two or three weeks after the completion of the second stage, the wound in the abdominal wall is closed by a plastic operation, and this constitutes the third and final stage. Each method of cholecystenterostomy has its advocates, but when the ease and rapidity with which the operation can be performed when an "anastomosis button" is made use of, are taken into consideration, and also the greater percentage of recoveries which have followed the use of this contrivance, it appears that this is the best operation to adopt in order to produce a fistulous communication between the gall bladder and the intestine. In order to avoid the misfortunes which may follow the too early separation of the "button," it appears to me that its use ought to be supplemented by a row of sutures inserted immediately outside the external margin, uniting the serous and muscular coats of the gall bladder and intestine. A row of sutures of this kind can be very quickly inserted after the viscera have been fixed in apposition with the "button," as this body acts as a kind of splint.

The operation of cholecystenterostomy appears to be indicated in the following conditions:—

(*a*) In all cases where the common bile duct is permanently obstructed or occluded, by adhesions, inflammatory processes, or malignant growths, the cystic duct remaining patent. The forms of new growth include those which are primary in the common bile duct and those which commence in the head of the pancreas and spread to it by direct extension. In cases where the common bile duct is occluded, as the result of secondary malignant growths, it is not advisable to perform the operation.

(*b*) In all cases of complete division of the common bile duct as the result of injury or operative measures.

(*c*) In cases of chronic biliary fistulæ which cannot be cured by the performance of a plastic operation, or in which the fistulæ are due to obstruction of the common bile duct which is not amenable to direct surgical interference.

(*d*) In all cases of perforation of the common bile duct which result from an ulcerative process.

(*e*) In cases of kinking of the common bile duct which are due to the presence of fibrous adhesions and cannot be remedied by operation.

Cholecystenterostomy is contraindicated in cases of well-established cholæmia, where the patient is suffering from exhaustion.

In the first list of cases of cholecystenterostomy (comprising records of seventeen patients) which Murphy published, no fatal terminations were reported, but in a later communication he gave an account of fatal results having been met with when the operation had been done in certain cases of malignant disease. Martig[1] has collected details of twenty-four cases which had been reported up to 1893, and of these fifteen were successful, six died directly from the operation, and three after the operation from indirect causes.

*Cholecysto-lithotripsy.*—This operation consists in opening the abdomen, exposing the gall bladder and bringing it into the abdominal wound, and crushing or breaking up into fragments any calculi which may happen to be in its interior, by applying pressure through the wall of the gall bladder. The calculi may either be crushed between the fingers or with forceps, the blades of which have been covered with tubes of indiarubber. When the calculi have been broken up in this manner, they are forced into the cystic duct, whence they pass along the biliary canal into the intestine. In this operation no incision is made in the walls of the gall bladder. Two cases treated by this method have been reported by Mayo Robson, and in both success followed. It seems to be probable that a considerable risk is run of causing such local injury to the wall of the gall bladder during the crushing, especially in the case of hard calculi, that ulceration and localised gangrene may result, and therefore it is questionable whether this method of treatment can be safely recommended. In cases where the calculi are small and of soft consistency, it may be justifiable to attempt their removal in this way. Further details of results of this method of treatment of gall stones situated within the gall bladder, are required before a definite opinion can be formed as to the exact value of the operation.

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[1] Martig, *op. cit.*

# CHAPTER XXVI.

## OPERATIONS UPON THE BILIARY DUCTS.

*Choledocho-lithotomy—choledochotomy.*—This operation has for its object the removal of one or more calculi from the interior of the common bile duct, in cases in which an obstruction to the flow of bile along this canal has been established, or in which severe symptoms result from the impaction. In performing the operation the abdominal cavity is opened by an incision which is made either in the linea alba, commencing above immediately below the ensiform cartilage, or in the right linea semilunaris, commencing just below the costal margin. It is not always possible to make an exact diagnosis as regards the seat of the impacted calculi, and when this is the case it is better to make the incision in the linea semilunaris. When the abdominal cavity has been opened, the course of the biliary tract is examined with the finger; the gall bladder should be examined first, then the cystic duct, and then the common bile duct, both as it lies in the gastro-hepatic omentum and in its course behind the first part of the duodenum, and where it lies between and behind the head of the pancreas and the left aspect of the second portion of the duodenum. In many cases, placing the examining finger in the foramen of Winslow will be found to be of diagnostic value, since in this position a considerable extent of the common bile duct can be palpated, and if there is a calculus in its interior its position can be at once made out. When a stone is discovered in the common bile duct, the gastro-hepatic omentum and the common bile duct are drawn into the abdominal wound. The peritoneal cavity around these structures is packed with sponges, and an incision is made in the common bile duct over the calculus, this incision being parallel to the long axis of the duct. Through this incision the impacted calculus is extracted, care being taken to damage the walls of the duct as little as possible. In order to facilitate the removal of the calculus, it is found in some cases to be advantageous to break up the stone with crushing forceps and to extract it in several fragments. When the stone has been removed, the area of the operation is thoroughly irrigated, and the margins of the incision in the common bile duct are then approximated and fixed in apposition by the insertion of two tiers of fine silk sutures. The first unites the mucous membrane, and the second the muscular and serous coats. If the peritoneum which forms the anterior layer of the gastro-hepatic omentum has been dissected from the bile duct, it may be united separately from the muscular walls of the common duct, in which case three tiers of sutures will be requisite. The sponges are now removed from the peritoneum, and after further irrigation the abdominal incision is closed. In many cases of this operation it will be found advisable to pack the region of the incision in the common duct with a strip of aseptic gauze, and to bring out the end of this strip through an angle of the abdominal wound, which is left open for the purpose. This strip is removed after one or two days, and if there is no sign of leakage from the duct, the abdominal wound is entirely closed. The strip of gauze is replaced by a similar one when any small quantity of fluid escapes. Michaux advises that, if the gall bladder is very dilated at the time of the operation, it should be incised and its contents evacuated, and that if it is filled with small calculi it should be removed. He advocates the closure of the wound in the common bile duct with sutures, after the removal of the calculus, and packing with a tampon of iodoform gauze. He records two cases, one being successful. In one case which has been operated upon by Frank, the wound in the duct was left open and a drain inserted; the operation

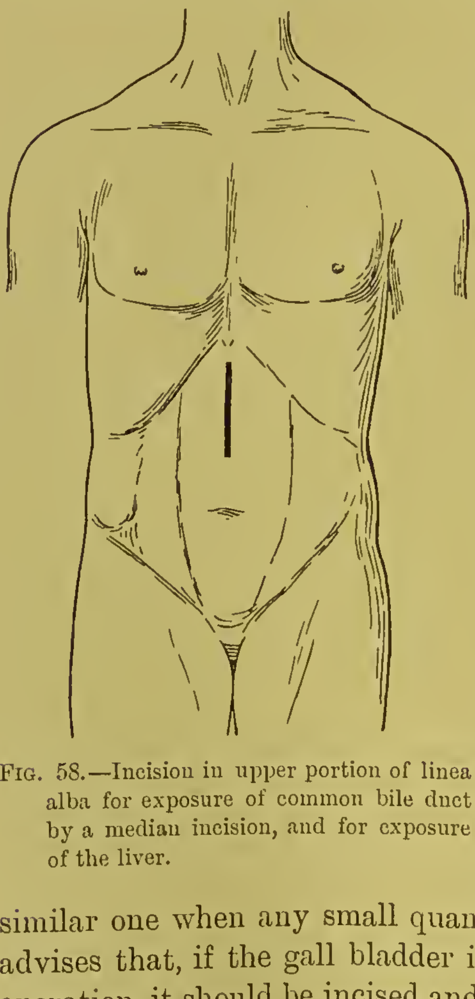

FIG. 58.—Incision in upper portion of linea alba for exposure of common bile duct by a median incision, and for exposure of the liver.

was successful. Quenu also recommends that the wound in the duct should not be sutured. It is sometimes found that the impacted calculus lies behind the duodenum, and then it is necessary to lift up this structure and open the common bile duct, as it lies behind it. If the calculus is a small one, or the common bile duct is considerably dilated, an attempt may be made to manipulate the calculus into the duodenum, by forcing it along the duct and through the orifice on the biliary papilla.

The indications for the operation of choledocho-lithotomy or choledochotomy are as follows:—

(*a*) When the cystic duct is closed and obliterated, and there is a simultaneous obstruction of the common bile duct, owing to the impaction of a calculus.

(*b*) In cases of perforation of the walls of the common bile duct by a calculus, when the walls of the duct are in a comparatively healthy condition; that is to say, when there are no signs of a septic inflammation.

(*c*) In cases of impaction of a calculus in the common duct, and the presence of the calculus is causing attacks of biliary colic and ague-like fever.

In twenty-seven cases of choledocho-lithotomy which have been collected by Martig, twenty-one recovered, five died from the operation, and in one the result was uncertain. Terrier has performed the operation many times, and says that the percentage of mortality is about 17 per cent. Mermann[1] has recently published records of four cases, three being successful and one fatal from cholæmia. Hans Kehr has performed the operation of choledochotomy upon twenty-eight patients, with two fatal results. One of these patients died from acute dilatation of the stomach following a kinking of the duodenum, owing to the presence of adhesions between it and the gall bladder; and the other from acute septic peritonitis, which was induced by the occurrence of a perforation of the wall of the fistula between the gall bladder and the colon during an attack of vomiting. A successful case has also been recently recorded by Mr. Anderson. Jourdan[2] has recently collected the records and results of seventy-two cases of choledochotomy which had been published up to 1895. Fifty cases recovered and twenty-two terminated fatally.

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[1] Mermann, *op cit.*

[2] Jourdan, "De la Cholédochotomie," Paris, 1895.

*Choledochostomy.*—Choledochostomy implies the creation of a cutaneous fistula which communicates with the lumen of the common bile duct. The operation has only been performed a few times, and in each case it was for an abdominal tumour, situated immediately below the liver, which was due to an enormous dilatation of the common bile duct. In most cases the abdomen has been opened before the nature of the swelling became apparent. Winiwarter operated upon a case in which the condition of dilated common bile duct was recognised before the operation. The operation is similar to that of cholecystotomy, and consists in opening the abdomen by an incision in the right linea semilunaris, incising the dilated common bile duct, and stitching the margins of the incision to those of the parietal wound. All the patients who have been operated upon in this manner have died, and, owing to the rarity of the condition, it is difficult to formulate any rules for the diagnosis of the dilated bile duct and its treatment by operation. If, however, when the abdomen has been opened, and this condition is discovered, evacuation of the contents of the dilated duct through an incision in its walls appears to be the only rational method of treatment. If in a case of this kind the communication between the common bile duct and the duodenum has become obliterated, and the connection between the gall bladder and the hepatic duct is not interfered with, the performance of a cholecystenterostomy seems to be indicated.

*Choledocho-enterostomy.* — This operation consists in the establishment of a fistulous communication between the cavity of a dilated common bile duct and the lumen of the alimentary canal, usually the duodenum. Sprengel performed the operation on a patient in whom the common bile duct was considerably dilated on account of a large calculus. The details of the method of performance of the operation are similar to those which were described in connection with cholecystenterostomy.

*Choledocho-lithotrity or choledocho-lithotripsy.*—By this term is understood the crushing of a calculus which is impacted in the common bile duct, by the application of padded forceps to the exterior, and without any incision of the walls of the duct. The operation is similar to that of cholecysto-lithotripsy, and was first performed by Langenbuch in 1886. It appears probable that when this operation has been performed, ulceration and gangrene of the mucous membrane of the bile duct may result owing to the injuries which have been inflicted upon it during the process of crushing, or that all the fragments of calculus will not pass into the duodenum, but some of them remain and become the nuclei of other large calculi. In those cases in which a calculus has been exposed in the common bile duct by an incision, it is occasionally useful to break it into several fragments by crushing before attempting its removal, but in these cases the forceps are applied directly to the calculus as it lies embedded in the duct. This operation appears to have been performed eleven times; eight were successful.

*Choledochectomy, or excision of a portion of the common bile duct.*—The early stages of the operation are the same as those in choledocho-lithotomy, and when the gastro-hepatic omentum with the common bile duct have been exposed, the duct is separated from its surroundings above and below the portion which it is proposed to excise, and then silk ligatures are applied to the duct proximally and distally to the diseased portion. The duct is then divided transversely above and below the portion which it is proposed to excise, and the separated part removed. The mucous membrane of the two ends of the divided duct should then be cauterised with the needle of a Paquelin's cautery, or thoroughly scraped with a small sharp spoon. The peritoneum is then stitched over the space formerly occupied by the excised part of the duct, and a cholecyst-enterostomy is performed, so as to allow the bile to pass from the liver into the intestine.

This operation appears to be indicated in the following pathological conditions:—

(*a*) In cases of localised malignant growths of the common bile duct which are not associated with the presence of secondary deposits in other viscera, and which do not involve the portal vein and the hepatic artery, or extend to the cystic duct or the hepatic ducts.

(*b*) In a few cases of impacted calculi in the common bile duct which have caused extensive ulceration and inflammation.

(*c*) In papillomata of the common bile duct which involve a considerable area of mucous membrane.

Owing to the difficulty of the diagnosis of the conditions which have been enumerated as indicating the performance of this operation, it will be rarely found possible to make use of this procedure. Experimentally, I have removed a small part of the common bile duct in a dog, and at the same time performed a cholecystenterostomy, and the operation was followed by recovery of the animal.

*Choledochotomy* (*by a lumbar incision*).—Terrier has proposed, in cases in which a gall stone has become impacted in the lower portion of the common bile duct—that is to say, in the ampulla of Vater—that an incision should be made in the right lumbar region parallel to and immediately below the lower border of the last rib. This is deepened until the kidney is exposed, when this organ is pulled downwards, and the dissection is prolonged upwards and inwards, until the common bile duct is exposed as it lies behind the duodenum and the head of the pancreas. If it is found to contain a stone, this is removed either through an incision in the wall of the duct, or it is manipulated with the fingers into the duodenum. Terrier has performed this operation on the dead body, and he thinks it is a method of procedure which may be introduced with advantage into modern surgery. The difficulties which may be met with during the process of dissection, the great depth of the common bile duct from the surface in persons who are inclined to be stout, and the immediate proximity of the inferior vena cava and other large blood vessels, appear to militate very strongly against the introduction of this operation as a form of treatment for impacted gall stones.

*Internal choledocho-duodenostomy.*—Kocher has performed an operation upon a patient who was suffering from chronic jaundice with symptoms of gall stones, which he has called by the above name. The abdominal cavity was opened and the gall bladder and bile ducts examined. The gall bladder was small, and contained only a moderate amount of bile, whilst in the common bile duct, in that portion which lies behind the duodenum, a calculus the size of a pigeon's egg was found. Attempts were made to crush it with forceps, but unsuccessfully. A transverse incision was then made in the anterior wall of the second portion of the duodenum, and the calculus was separated from its connections by incising the posterior wall of the duodenum and the part of the common bile duct which enclosed the calculus. After the gall stone had been removed, the margins of the wound in the common bile duct were sutured to those of the wound in the posterior part of the duodenum, and the incision in the anterior wall of the gut was then closed with sutures. The wound in the abdominal wall was closed except at one point, which was left open for a drainage-tube which had been passed down to the region of the incisions in the duodenum and common bile duct. During the course of the operation hæmorrhage from the pancreas was encountered but this was arrested by the application of gauze pads. M'Burney of New York has described a similar case in which he incised the anterior wall of the second portion of the duodenum and then dilated the orifice of the common bile duct, and removed through the dilated aperture a gall stone which had been impacted in the lower part of the common bile duct. In those cases in which the impacted calculus is large, dilatation of the biliary orifice in the duodenum is not sufficient, and it is necessary to incise the duct. The performance of the operation of internal choledocho-duodenostomy is indicated when a calculus is impacted in the ampulla of Vater, and cannot be dislodged by other and less severe measures.

*Cystico-lithotomy.*—It is requisite in some cases of cholelithiasis, in which a calculus has become arrested in the cystic duct, and has withstood all attempts to remove it, either by an operation carried out from the interior of the gall bladder, or by manipulation from the exterior of the duct itself, to incise the wall of the cystic duct so as to enable the surgeon to extract the calculus. The early stages of the operation are like those of choledocho-lithotomy, and the incision of the cystic duct is made in a manner similar to that which is employed in incision of the common bile duct; after the calculus has been removed the margins of the incision are united in a like manner with sutures. In the majority of cases of gall stones impacted in the cystic duct, which cannot be removed through the gall bladder, it will be found advisable to remove the gall bladder and that portion of the cystic duct which encloses the calculus, since the inflammation which results from the presence of the impacted stone often terminates in the obliteration of the lumen of the cystic canal by a fibrous constriction; and the establishment of this condition is in most cases subsequently followed by a distension of the gall bladder with a quantity of mucus secreted by the mucous glands in its walls. If, however, the walls of the cystic duct are in a moderately healthy state and not the seat of extensive inflammation and ulceration, the stone may be removed and the margins of the incision in the walls of the duct closed.

Before incising the cystic duct, an attempt should always be made to manipulate the calculus backwards into the cavity of the gall bladder. Digital manipulation from without and dilatation of the cystic duct from within the gall bladder often succeed in bringing about the extraction of the calculus.

The common hepatic duct has been incised in a manner similar to that which has been described for the common bile duct and the cystic duct, and the margins of the incision stitched to the lips of the abdominal wall. This operation has been performed unsuccessfully by Kocher. The operation has been called "hepaticostomy."

*Catheterism of the biliary passages.*—It is occasionally necessary to examine the course of the bile ducts with a catheter or sound. The operation may be performed either through a biliary fistula which opens upon the surface of the abdomen, or during the course of an operation when some portion of the bile canal has been incised. For the purpose of sounding or passing a catheter along the bile canal, a soft olive-headed bougie is the best instrument to use. Solid metal instruments are very prone to be the cause of the establishment of false passages or to cause a rupture of the canal. This procedure has been made use of both as a means of diagnosis and as a form of treatment. It cannot be said, however, that good results have followed its employment. In certain cases it is possible to locate a stone or the situation of a stricture, but the information which is obtained in this manner cannot always be relied upon.

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